Metribuzin
Analysis of Risks
to
Endangered and Threatened Salmon and Steelhead

July 15, 2004[1]

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Summary

Metribuzin is a triazinone herbicide registered for use on asparagus, carrots, corn, sugarcane, potatoes, sorghum, soybeans, barley, tomato, garbanzo, peas, uncultivated areas, recreational turf areas, wheat, alfalfa, hay, and pastures. Metribuzin may be applied preplant, preemergence, postemergence, or post transplant using ground equipment, chemigation, or as an aerial spray. The registered modes of application are band treatment, directed spray, broadcast spray, soil incorporation, and spot spray. The most current EPA records show 66 active end-use product registrations.

Metribuzin functions as an herbicide through the inhibition of electron transport in the photosynthesis pathways. It is approved for a wide range of noxious broadleaf weeds. The Agency has determined that it is practically nontoxic to fish and aquatic/marine invertebrates. The chemical is highly effective in eliminating target plants however. Because of the natural association of salmon and steelhead with streams in the upper reaches of rivers closely associated with coniferous forest lands, this is not a major concern.

The main use of metribuzin is to control germinating and newly emerging grasses and broad leaf weeds in soybeans, field crops, and potatoes. Generally, it is applied sparsely to very small portions of the crop (0.04% in hay, 0.1% in barley) and is commonly used as a “spot treatment” by aerosol spray. The highest use rates and applications (1998 RED, attachment 1) are in potato (66% of the crop) and dry peas (59% of the crop). Other high use sites are tomato (56% of the crop) and asparagus (56% of the crop). These data reflect usage from 1990 to 1994. In the areas of concern for this review these crops are not large scale application sites. Combined with the Agency decision that this chemical is essentially non-toxic to fish and aquatic invertebrates it is anticipated that this chemical will have no adverse effects on the listed salmon and steelhead populations in California and the Pacific Northwest.

[1] Comment: Data and the analysis based upon it reflects information available at the time this report was completed. Additional data, which may be submitted or change in status after the submission data that are not included in the authors evaluations, presentations, or comments.

Scope - Although this analysis is specific to listed western salmon and steelhead and the watersheds in which they occur, it is acknowledged that Metribuzin is registered for uses that may occur outside this geographic scope and that additional analyses may be required to address other T&E species in the Pacific states as well as across the United States. I understand that any subsequent analyses, requests for consultation, and resulting Biological Opinions may necessitate that Biological Opinions relative to this request be revisited, and could be modified. Much of the quantitative information presented and used was derived from the Registration Eligibility Decision (RED; Attachment 1).

Contents

Attachments:
1. Reregistration Eligibility Decision for Metribuzin, Case No 0043
2. EPA Quantitative Usage Analysis, Metribuzin
3. Example Labels
4. USGS Pesticide Use Map for Metribuzin

1. Background

Under section 7 of the Endangered Species Act, the Office of Pesticide Programs (OPP) of the U. S. Environmental Protection Agency (EPA) is required to consult on actions that may affect Federally listed endangered or threatened species or that may adversely modify designated critical habitat. Situations where a pesticide may affect a fish, such as any of the salmonid species listed by the National Marine Fisheries Service (NMFS), include either direct or indirect effects on the fish. Direct effects result from exposure to a pesticide at levels that may cause harm.

Acute Toxicity - Relevant acute data are derived from standardized toxicity tests with lethality as the primary endpoint. These tests are conducted with what is generally accepted as the most sensitive life stage of fish, i.e., very young fish from 0.5-5 grams in weight, and with species that are usually among the most sensitive. These tests for pesticide registration include analysis of observable sublethal effects as well. The intent of acute tests is to statistically derive a median effect level; typically the effect is lethality in fish (LC50) or immobility in aquatic invertebrates (EC50). Typically, a standard fish acute test will include concentrations that cause no mortality, and often no observable sublethal effects, as well as concentrations that would cause 100% mortality. By looking at the effects at various test concentrations, a dose-response curve can be derived, and one can statistically predict the effects likely to occur at various pesticide concentrations; a well done test can even be extrapolated, with caution, to concentrations below those tested (or above the test concentrations if the highest concentration did not produce 100% mortality).

OPP typically uses qualitative descriptors to describe different levels of acute toxicity, the most likely kind of effect of modern pesticides (Table 1). These are widely used for comparative purposes, but must be associated with exposure before any conclusions can be drawn with respect to risk. Pesticides that are considered highly toxic or very highly toxic are required to have a label statement indicating that level of toxicity. The FIFRA regulations [40CFR158.490(a)] do not require calculating a specific LC50 or EC50 for pesticides that are practically non-toxic; the LC50 or EC50 would simply be expressed as >100 ppm. When no lethal or sublethal effects are observed at 100 ppm, OPP considers the pesticide will have "no effect" on the species.

Table 1. Qualitative descriptors for categories of fish and aquatic invertebrate toxicity (from Zucker, 1985)

LC50 or EC50	Category description
< 0.1 ppm	Very highly toxic
0.1- 1 ppm	Highly toxic
>1 < 10 ppm	Moderately toxic
> 10 < 100 ppm	Slightly toxic
> 100 ppm	Practically non-toxic

Comparative toxicology has demonstrated that various species of scaled fish generally have equivalent sensitivity, within an order of magnitude, to other species of scaled fish tested under the same conditions. Exceptions are known to occur for only an occasional pesticide, as based on the several dozen fish species that have been frequently tested. Sappington et al. (2001), Beyers et al. (1994) and Dwyer et al. (1999), among others, have shown that endangered and threatened fish tested to date are similarly sensitive, on an acute basis, to a variety of pesticides and other chemicals as are their non-endangered counterparts.

Chronic Toxicity - OPP evaluates the potential chronic effects of a pesticide on the basis of several types of tests. These tests are often required for registration, but not always. If a pesticide has essentially no acute toxicity at relevant concentrations, or if it degrades very rapidly in water, or if the nature of the use is such that the pesticide will not reach water, then chronic fish tests may not be required [40CFR158.490]. Chronic fish tests primarily evaluate the potential for reproductive effects and effects on the offspring. Other observed sublethal effects are also required to be reported. An abbreviated chronic test, the fish early-life stage test, is usually the first chronic test conducted and will indicate the likelihood of reproductive or chronic effects at relevant concentrations. If such effects are found, then a full fish life-cycle test will be conducted. If the nature of the chemical is such that reproductive effects are expected, the abbreviated test may be skipped in favor of the full life-cycle test. These chronic tests are designed to determine a "no observable effect level" (NOEL) and a "lowest observable effect level" (LOEL). A chronic risk requires not only chronic toxicity, but also chronic exposure, which can result from a chemical being persistent and resident in an environment (e.g., a pond) for a chronic period of time or from repeated applications that transport into any environment such that exposure would be considered "chronic".

As with comparative toxicology efforts relative to sensitivity for acute effects, EPA, in conjunction with the U. S. Geological Survey, has a current effort to assess the comparative toxicology for chronic effects also. Preliminary information indicates, as with the acute data, that endangered and threatened fish are again of similar sensitivity to similar non-endangered species.

Metabolites and Degradates - Information must be reported to OPP regarding any pesticide metabolites or degradates that may pose a toxicological risk or that may persist in the environment [40CFR159.179]. Toxicity and/or persistence test data on such compounds may be required if, during the risk assessment, the nature of the metabolite or degradate and the amount that may occur in the environment raises a concern. If actual data or structure-activity analyses are not available, the requirement for testing is based upon best professional judgement.

Inert Ingredients - OPP does take into account the potential effects of what used to be termed "inert" ingredients, but which are beginning to be referred to as "other ingredients". OPP has classified these ingredients into several categories. A few of these, such as nonylphenol, can no longer be used without including them on the label with a specific statement indicating the potential toxicity. Based upon our internal databases, I can find no product in which nonylphenol is now an ingredient. Many others, including such ingredients as clay, soybean oil, many polymers, and chlorophyll, have been evaluated through structure-activity analysis or data and determined to be of minimal or no toxicity. There exist also two additional lists, one for inerts with potential toxicity which are considered a testing priority, and one for inerts unlikely to be toxic, but which cannot yet be said to have negligible toxicity. Any new inert ingredients are required to undergo testing unless it can be demonstrated that testing is unnecessary.

The inerts efforts in OPP are oriented only towards toxicity at the present time, rather than risk. It should be noted, however, that very many of the inerts are in exceedingly small amounts in pesticide products. While some surfactants, solvents, and other ingredients may be present in fairly large amounts in various products, many are present only to a minor extent. These include such things as coloring agents, fragrances, and even the printers ink on water soluble bags of pesticides. Some of these could have moderate toxicity, yet still be of no consequence because of the negligible amounts present in a product. If a product contains inert ingredients in sufficient quantity to be of concern, relative to the toxicity of the active ingredient, OPP attempts to evaluate the potential effects of these inerts through data or structure-activity analysis, where necessary.

For a number of major pesticide products, testing has been conducted on the formulated end-use products that are used by the applicator. The results of fish toxicity tests with formulated products can be compared with the results of tests on the same species with the active ingredient only. A comparison of the results should indicate comparable sensitivity, relative to the percentage of active ingredient in the technical versus formulated product, if there is no extra activity due to the combination of inert ingredients. I note that the "comparable" sensitivity must take into account the natural variation in toxicity tests, which is up to 2-fold for the same species in the same laboratory under the same conditions, and which can be somewhat higher between different laboratories, especially when different stocks of test fish are used.

The comparison of formulated product and technical ingredient test results may not provide specific information on the individual inert ingredients, but rather is like a "black box" which sums up the effects of all ingredients. I consider this approach to be more appropriate than testing each individual inert and active ingredient because it incorporates any additivity, antagonism, and synergism effects that may occur and which might not be correctly evaluated from tests on the individual ingredients. I do note, however, that we do not have aquatic data on most formulated products, although we often have testing on one or perhaps two formulations of an active ingredient.

Risk - An analysis of toxicity, whether acute or chronic, lethal or sublethal, must be combined with an analysis of how much will be in the water, to determine risks to fish. Risk is a combination of exposure and toxicity. Even a very highly toxic chemical will not pose a risk if there is no exposure, or very minimal exposure relative to the toxicity. OPP uses a variety of chemical fate and transport data to develop "estimated environmental concentrations" (EECs) from a suite of established models. The development of aquatic EECs is a tiered process.

The first tier screening model for EECs is with the GENEEC program, developed within OPP, which uses a generic site (in Yazoo, MS) to stand for any site in the U. S. The site choice was intended to yield a maximum exposure, or "worst-case," scenario applicable nationwide, particularly with respect to runoff. The model is based on a 10 hectare watershed that surrounds a one hectare pond, two meters deep. It is assumed that all of the 10 hectare area is treated with the pesticide and that any runoff would drain into the pond. The model also incorporates spray drift, the amount of which is dependent primarily upon the droplet size of the spray. OPP assumes that if this model indicates no concerns when compared with the appropriate toxicity data, then further analysis is not necessary as there would be no effect on the species.

It should be noted that prior to the development of the GENEEC model in 1995, a much more crude approach was used to determining EECs. Older reviews and Reregistration Eligibility Decisions (REDs) may use this approach, but it was excessively conservative and does not provide a sound basis for modern risk assessments. For the purposes of endangered species consultations, we will attempt to revise this old approach with the GENEEC model, where the old screening level raised risk concerns.

When there is a concern with the comparison of toxicity with the EECs identified in GENEEC model, a more sophisticated PRZM-EXAMS model is run to refine the EECs if a suitable scenario has been developed and validated. The PRZM-EXAMS model was developed with widespread collaboration and review by chemical fate and transport experts, soil scientists, and agronomists throughout academia, government, and industry, where it is in common use. As with the GENEEC model, the basic model remains as a 10 hectare field surrounding and draining into a 1 hectare pond. Crop scenarios have been developed by OPP for specific sites, and the model uses site-specific data on soils, climate (especially precipitation), and the crop or site. Typically, site-scenarios are developed to provide for a worst-case analysis for a particular crop in a particular geographic region. The development of site scenarios is very time consuming; scenarios have not yet been developed for a number of crops and locations. OPP attempts to match the crop(s) under consideration with the most appropriate scenario. For some of the older OPP analyses, a very limited number of scenarios were available. As more scenarios become available and are geographically appropriate to selected T&E species, older models used in previous analyses may be updated.

One area of significant weakness in modeling EECs relates to residential uses, especially by homeowners, but also to an extent by commercial applicators. There are no usage data in OPP that relate to pesticide use by homeowners on a geographic scale that would be appropriate for an assessment of risks to listed species. For example, we may know the maximum application rate for a lawn pesticide, but we do not know the size of the lawns, the proportion of the area in lawns, or the percentage of lawns that may be treated in a given geographic area. There is limited information on soil types, slopes, watering practices, and other aspects that relate to transport and fate of pesticides. We do know that some homeowners will attempt to control pests with chemicals and that others will not control pests at all or will use non-chemical methods. We would expect that in some areas, few homeowners will use pesticides, but in other areas, a high percentage could. As a result, OPP has insufficient information to develop a scenario or address the extent of pesticide use in a residential area.

It is, however, quite necessary to address the potential that home and garden pesticides may affect T&E species, even in the absence of reliable data. Therefore, a hypothetical scenario, by adapting an existing scenario can be used to address pesticide use on home lawns where it is most likely that residential pesticides will be used outdoors. It is exceedingly important to note that there is no quantitative, scientifically valid support for this modified scenario; rather it is based on best professional judgement. Three approaches will be used. First, the treatment of ornamental turf will represent situations where a high proportion of homeowners may use a pesticide. Second, a 10% treatment will represent situations where only some homeowners may use a pesticide. Even if OPP cannot reliably determine the percentage of homeowners using a pesticide in a given area, this will provide two estimates. Third, where the risks from recreational turf use could exceed our criteria by only a modest amount the percentage of land that would need to be treated to exceed our criteri can be back calculated.. If a smaller percentage is treated, this would then be below our criteria of concern. The percentage here would be not just of recreational turf, but of all of the treatable area under consideration. In urban and highly populated suburban areas, it would be similar to a percentage of lawns. Should reliable data or other information become available, the approach will be altered appropriately.

It is also important to note that pesticides used in urban areas can be expected to transport considerable distances if they should run off on to concrete or asphalt, such as with streets (e.g., TDK Environmental, 2001). This makes any quantitative analysis very difficult to address aquatic exposure from recreational use. It also indicates that a no-use or no-spray buffer approach for protection, which we consider quite viable for agricultural areas, may not be particularly useful for urban areas.

Finally, the applicability of the overall EEC scenario, i.e., the 10 hectare watershed draining into a one hectare farm pond, may not be appropriate for a number of T&E species living in rivers or lakes. This scenario is intended to provide a "worst-case" assessment of EECs, but very many T&E fish do not live in ponds, and very many T&E fish do not have all of the habitat surrounding their environment treated with a pesticide. OPP does believe that the EECs from the farm pond model do represent first order streams, such as those in headwaters areas (Effland, et al. 1999). In many agricultural areas, those first order streams may be upstream from pesticide use, but in other areas, or for some non-agricultural uses such as forestry, the first order streams may receive pesticide runoff and drift. However, larger streams and lakes will very likely have lower, often considerably lower, concentrations of pesticides due to more dilution by the receiving waters. In addition, where persistence is a factor, streams will tend to carry pesticides away from where they enter into the streams, and the models do not allow for this. The variables in size of streams, rivers, and lakes, along with flow rates in the lentic waters and seasonal variation, are large enough to preclude the development of applicable models to represent the diversity of T&E species' habitats. We can simply qualitatively note that the farm pond model is expected to overestimate EECs in larger bodies of water.

Indirect Effects - We also attempt to protect listed species from indirect effects of pesticides. We note that there is often not a clear distinction between indirect effects on a listed species and adverse modification of critical habitat (discussed below). By considering indirect effects first, we can provide appropriate protection to listed species even where critical habitat has not been designated. In the case of fish, the indirect concerns are routinely assessed for food and cover.

The primary indirect effect of concern would be for the food source for listed fish. These are best represented by potential effects on aquatic invertebrates, although aquatic plants or plankton may be relevant food sources for some fish species. However, it is not necessary to protect individual organisms that serve as food for listed fish. Thus, our goal is to ensure that pesticides will not impair populations of these aquatic arthropods. In some cases, listed fish may feed on other fish. Because our criteria for protecting the listed fish species is based upon the most sensitive species of fish tested, then by protecting the listed fish species, we are also protecting the species used as prey.

In general, but with some exceptions, pesticides applied in terrestrial environments will not affect the plant material in the water that provides aquatic cover for listed fish. Application rates for herbicides are intended to be efficacious, but are not intended to be excessive. Because only a portion of the effective application rate of an herbicide applied to land will reach water through runoff or drift, the amount is very likely to be below effect levels for aquatic plants. Some of the applied herbicides will degrade through photolysis, hydrolysis, or other processes. In addition, terrestrial herbicide applications are efficacious in part, due to the fact that the product will tend to stay in contact with the foliage or the roots and/or germinating plant parts, when soil applied. With aquatic exposures resulting from terrestrial applications, the pesticide is not placed in immediate contact with the aquatic plant, but rather reaches the plant indirectly after entering the water and being diluted. Aquatic exposure is likely to be transient in flowing waters. However, because of the exceptions where terrestrially applied herbicides could have effects on aquatic plants, OPP does evaluate the sensitivity of aquatic macrophytes to these herbicides to determine if populations of aquatic macrophytes that would serve as cover for T&E fish would be affected.

For most pesticides applied to terrestrial environment, the effects in water, even lentic water, will be relatively transient. Therefore, it is only with very persistent pesticides that any effects would be expected to last into the year following their application. As a result, and excepting those very persistent pesticides, we would not expect that pesticidal modification of the food and cover aspects of critical habitat would be adverse beyond the year of application. Therefore, if a listed salmon or steelhead is not present during the year of application, there would be no concern. If the listed fish is present during the year of application, the effects on food and cover are considered as indirect effects on the fish, rather than as adverse modification of critical habitat.

Designated Critical Habitat - OPP is also required to consult if a pesticide may adversely modify designated critical habitat. In addition to the indirect effects on the fish, we consider that the use of pesticides on land could have such an effect on the critical habitat of aquatic species in a few circumstances. For example, use of herbicides in riparian areas could affect riparian vegetation, especially woody riparian vegetation, which possibly could be an indirect effect on a listed fish. However, there are very few pesticides that are registered for use on riparian vegetation, and the specific uses that may be of concern have to be analyzed on a pesticide by pesticide basis. In considering the general effects that could occur and that could be a problem for listed salmonids, the primary concern would be for the destruction of vegetation near the stream, particularly vegetation that provides cover or temperature control, or that contributes woody debris to the aquatic environment. Destruction of low growing herbaceous material would be a concern if that destruction resulted in excessive sediment loads getting into the stream, but such increased sediment loads are insignificant from cultivated fields relative to those resulting from the initial cultivation itself. Increased sediment loads from destruction of vegetation could be a concern in uncultivated areas. Any increased pesticide load as a result of destruction of terrestrial herbaceous vegetation would be considered a direct effect and would be addressed through the modeling of estimated environmental concentrations. Such modeling can and does take into account the presence and nature of riparian vegetation on pesticide transport to a body of water.

Risk Assessment Processes - All of our risk assessment procedures, toxicity test methods, and EEC models have been peer-reviewed by OPP's Science Advisory Panel. The data from toxicity tests and environmental fate and transport studies undergo a stringent review and validation process in accordance with "Standard Evaluation Procedures" published for each type of test. In addition, all test data on toxicity or environmental fate and transport are conducted in accordance with Good Laboratory Practice (GLP) regulations (40 CFR Part 160) at least since the GLPs were promulgated in 1989.

The risk assessment process is described in "Hazard Evaluation Division - Standard Evaluation Procedure - Ecological Risk Assessment" by Urban and Cook (1986) (termed Ecological Risk Assessment SEP below), which has been separately provided to National Marine Fisheries Service staff. Although certain aspects and procedures have been updated throughout the years, the basic process and criteria still apply. In a very brief summary: the toxicity information for various taxonomic groups of species is quantitatively compared with the potential exposure information from the different uses and application rates and methods. A risk quotient of toxicity divided by exposure is developed and compared with criteria of concern. The criteria of concern presented by Urban and Cook (1986) are presented in Table 2.

Table 2. Risk quotient criteria for direct and indirect effects on T&E fish

Test data	Risk quotient	Presumption
Acute LC_{50}	>0.5	Potentially high acute risk
Acute LC_{50}	>0.1	Risk that may be mitigated through restricted use classification
Acute LC_{50}	>0.05	Endangered species may be affected acutely, including sublethal effects
Chronic NOEC	>1	Chronic risk; endangered species may be affected chronically, including reproduction and effects on progeny
Acute invertebrate LC_{50}[a]	>0.5	May be indirect effects on T&E fish through food supply reduction

Aquatic plant acute EC_{50}[a]	>1[b]	May be indirect effects on aquatic vegetative cover for T&E fish

a. Indirect effects criteria for T&E species are not in Urban and Cook (1986); they were developed subsequently.
b. This criterion has been changed from our earlier requests. The basis is to bring the endangered species criterion for indirect effects on aquatic plant populations in line with EFED's concern levels for these populations.

The Ecological Risk Assessment SEP (pages 2-6) discusses the quantitative estimates of how the acute toxicity data, in combination with the slope of the dose-response curve, can be used to predict the percentage mortality that would occur at the various risk quotients. The discussion indicates that using a "safety factor" of 10, as applies for restricted use classification, one individual in 30,000,000 exposed to the concentration would be likely to die. Using a "safety factor" of 20, as applies to aquatic T&E species, would exponentially increase the margin of safety. It has been calculated by one pesticide registrant (without sufficient information for OPP to validate that number), that the probability of mortality occurring when the LC50 is 1/20th of the EEC is 2.39×10^{-9}, or less than one individual in ten billion. It should be noted that the discussion (originally part of the 1975 regulations for FIFRA) is based upon slopes of primarily organochlorine pesticides, stated to be 4.5 probits per log cycle at that time. As organochlorine pesticides were phased out, OPP undertook an analysis of more current pesticides based on data reported by Johnson and Finley (1980), and determined that the "typical" slope for aquatic toxicity tests for the "more current" pesticides was 9.95. Because the slopes are based upon logarithmically transformed data, the probability of mortality for a pesticide with a 9.95 slope is again exponentially less than for the originally analyzed slope of 4.5.

The above discussion focuses on mortality from acute toxicity. OPP is concerned about other direct effects as well. For chronic and reproductive effects, our criteria ensures that the EEC is below the no-observed-effect-level, where the "effects" include any observable sublethal effects. Because our EEC values are based upon "worst-case" chemical fate and transport data and a small farm pond scenario, it is rare that a non-target organism would be exposed to such concentrations over a period of time, especially for fish that live in lakes or in streams (best professional judgement). Thus, there is no additional safety factor used for the no-observed-effect-concentration, in contrast to the acute data where a safety factor is warranted because the endpoints are a median probability rather than no effect.

Sublethal Effects - With respect to sublethal effects, Tucker and Leitzke (1979) did an extensive review of existing ecotoxicological data on pesticides. Among their findings was that sublethal effects as reported in the literature did not occur at concentrations below one-fourth to one-sixth of the lethal concentrations, when taking into account the same percentages or numbers affected, test system, duration, species, and other factors. This was termed the "6x hypothesis". Their review included cholinesterase inhibition, but was largely oriented towards externally observable parameters such as growth, food consumption, behavioral signs of intoxication, avoidance and repellency, and similar parameters. Even reproductive parameters fit into the hypothesis when the duration of the test was considered. This hypothesis supported the use of lethality tests for use in assessing acute ecotoxicological risk, and the lethality tests are well enough established and understood to provide strong statistical confidence, which can not always be achieved with sublethal effects. By providing an appropriate safety factor, the concentrations found in lethality tests can therefore generally be used to protect from sublethal effects. As discussed earlier, the entire focus of the early-life-stage and life-cycle chronic tests is on sublethal effects.

In recent years, Moore and Waring (1996) challenged Atlantic salmon with diazinon and observed effects on olfaction as relates to reproductive physiology and behavior. Their work indicated that diazinon could have sublethal effects of concern for salmon reproduction. However, the nature of their test system, direct exposure of olfactory rosettes, could not be quantitatively related to exposures in the natural environment. Subsequently, Scholz et al. (2000) conducted a non-reproductive behavioral study using whole Chinook salmon in a model stream system that mimicked a natural exposure that is far more relevant to ecological risk assessment than the system used by Moore and Waring (1996). The Scholz et al. (2000) data indicate potential effects of diazinon on Chinook salmon behavior at very low levels, with statistically significant effects at nominal diazinon exposures of 1 ppb, with apparent, but non-significant effects at 0.1 ppb.

It would appear that the Scholz et al (2000) work contradicts the 6x hypothesis for acute effects. The research design, especially the nature and duration of exposure, of the test system used by Scholz et al (2000), along with a lack of dose-response, precludes comparisons with lethal levels in accordance with the 6x hypothesis as used by Tucker and Leitzke (1979). Nevertheless, it is known that olfaction is an exquisitely sensitive sense. And this sense may be particularly well developed in salmon, as would be consistent with its use by salmon in homing (Hasler and Scholz, 1983). So the contradiction of the 6x hypothesis is not surprising. As a result of these findings, the 6x hypothesis needs to be re-evaluated with respect to olfaction. At the same time, because of the sensitivity of olfaction and because the 6x hypothesis has generally stood the test of time otherwise, it would be premature to abandon the hypothesis for other acute sublethal effects until there are additional data.

2. Description of Metribuzin:

A. Chemical History: Metribuzin was first registered in the United States in 1973 for use as an herbicide. In July 1985, a Registration Standard (NITS #PB86-173216) was issued and required additional data on toxicology and ecological effects. The Standard classified metribuzin as a “Restricted Use” chemical based on possible groundwater infiltration. After submission and review of data submitted by the registrant, this classification was revoked.

B: Chemical Description:

- ❑ Common Name: Metribuzin
- ❑ Chemical Name:
  4-amino-6-(1,1-dimethylthio-3-(methylthio)1,2,4-triazin-5(4H)-one

- ❑ Chemical Family: Triazinone
- ❑ Case Number: 0181
- ❑ CAS Registry Number: 21087-64-9
- ❑ OPP Chemical Code: 101101
- ❑ Empirical Formula: $C_8H_{14}N_4OS$
- ❑ Molecular Weight: 214.28
- ❑ Trade and Other Names: Boundry®, Sencor®, Turbo®, Domain®, Authority®, Top Gun®,Canopy®
- ❑ Basic Manufacturer: .Bayer Crop Sciences

Technical metribuzin is a white, crystalline powder. It has a melting point of 126°C. It is soluble in water to approximately1,200 ppm. It is soluble in dimethylformamyde, chloroform, acetone, ethyl acetate, methanol, ethanol, toluene, xylene, and n-hexane.

C. Chemical Use: The following is based on the currently registered uses of Metribuzin:

- ❑ Type of Agent: Herbicide
- ❑ Mode of Action: Inhibition of Photosynthesis
- ❑ Classification: Non-restricted use herbicide
- ❑ Summary of Sites:
    - <u>Terrestrial Food/Feed Crops</u>: asparagus, carrots, wheat, barley, tomato, potato, corn, soybeans, peas, garbanzo, lentils, sugarcane
    - <u>Terrestrial Food + Feed Crops</u>: Bermuda grass, hay (forage/fodder), alfalfa, sainfoin
    - <u>Terrestrial Non-Food and Feed Crop:</u> Grasses grown for seed, recreation areas, uncultivated agricultural areas, pastures.
    - <u>Public Health</u>: None

- Target Pests:
  Broad leafs: annual polemonium, ageratum, ameranth, beggarweed bristly starbur, buffaloburr, buttercup, bedstraw, carpetweed, chickweeds, clover, cocklebur, coffeeweed, common ragweed, corn cockle, Carolina geranium, cutleaf evening primrose, dandelion, dayflower, dock, dogfennel, falsefax, field bindweed, field pennycress, fireweed, flixweed. Florida pulley, fumitory, galinsoga, haloe koa, henbit, hialoa, hophornbean, copperleaf, horsenettle, horseweed, jacobs lader, jimsonweed, knotweed, kochia, ladysthumb, lambsquatters, London rocket, mallow, marestail, meadow salsify, mexicanweed, minerslettuce, morning-glory, mustard, nettleleaf, goosefoot, parsley-piert, pepperweed, pigweed, pineappleweed, prickley lettuce, purple deadnettle, purslane, rattlebox, redweed, red tassel-flower, red sorrel, sand catchfy, sensitiveplant, sesbania, shepherds purse, sicklespod, spurred anoda, smartweed, snapweed, speedwell, spurge, spurge, sunflower, thistle, toadflax, velvetleaf, white champion, wild buckwheat, wild poinsettia. yellow jacket.

- Grasses: alexandergrass, barnyardgrass, bluegrass, broadleaf panicum, browntop millet, brome, cheat, crabgrass, crowfootgrass, fall panicum, field sandbar, foxtail, guineagrass, Italian ryegrass, johnsongrass, junglerice, littleseed canary grass, quackgrass, rabbitfoot polypogon, radiate fingergrass, rescuegrass, ricegrass, spring willowgrass, signalgrass, volunteer wheat, wild oat, windgrass, wiregrass.

❑ Formulation Types Registered:
Technical Grade/Manufacturing-Use Product (MUP) Bayer Corporation, 90% Solid. Wettable Powder, 50%

End-use Product:
Emulsifiable concentrate, 14-15%; flowable concentrate, 41%; water dispersable granules (dry flowable) 64.3 to 75%; wettable powder, 50 to 70%.

❑ Methods of Application:

- Equipment: Aircraft (fixed wing or helicopter), center pivot irrigation, low pressure ground sprayer, power sprayer, sprayer, sprinkler irrigation.

- Method and Rate: Band treatment, broadcast, chemigation.

conservation tillage, directed spray, low volume spray (concentrate), soil incorporation, spot treatment spray.

- Timing: At planting; dormant, early postemergence, early preplant, early spring, established plantings, fall, fallow, foliar late spring, layby, post final harvest, postemergence, post harvest, preemergence, preplant pretransplant (spring)

❑ Rates of Application (for CA, WA, OR, ID):

- ASPARAGUS: 1.1 lbs a.i./A
- BARLEY: 0.6 lbs a.i./A
- CARROTS: 0.2 lbs a.i./A
- WHEAT: 0.2 lbs a.i./A
- CORN: 0.2 lbs a.i./A
- PEAS, DRY: 0.3 lbs a.i./A
- PEAS, GREEN: 0.2 lbs a.i./A
- ALFALFA: 0.6 lbs a.i./A
- HAY: 0.4 lbs a.i./A
- ORNAMENTAL TURF (recreational) 1 lbs a.i./A
- POTATO: 0.5 lbs a.i./A
- PASTURE (mixed grass and alfalfa): 1 lbs a.i./A
- TOMATO: 0.5 lbs a.i./A

Metribuzin is commonly found as a component of end use products, such as Axiom® (Flufenacet), Domain® (Flufenacet)), or Authority® (Sulfentrazone). A review of open literature did not indicate synergistic or antagonistic effects by the combination of ingredients in a single application product.

D. Environmental Fate:

Based on current data, the primary modes of degradation of metribuzin and its primary degradates, diketo metribuzin (DK) and deaminated diketo metribuzin (DADK) are microbial metabolism and photdegradation (on soil). These compounds are not volatile. In clear, surface water, with exposure to sunlight, the chemicals are not expected to persist, with a calculated half-life in clear, well-mixed, shallow water with good light penetration of 4.3 hours.

Metribuzin (and DK and DADK) are stable in aqueous buffer (ph 5,7, and 9) at 25° C. At pH 6.6 in water with solar radiation (Kansas City, MO), metribuzin had a half-life of 4.3 hours. Parent metribuzin is very mobile in soil. In sandy soil 0.58% OC, sandy loam 0,64% OC, silt loam 1.68% OC, and clay-loam 1.28% OC. The Freundlch K_{ads} values were 0.25, 0.02, 0.22, and 0.20 respectively. K_{des} values were 0.56, 0.14, 0.51, and 0.41. K_{ocads} were 47, 3, 15, and 17. K_{ocdes} values on these same soils were 106, 24, 33, and 36, respectively. The N values were 0.92, 0.66, 0.86, and 0.94 for adsorption and 0.76, 0.60, 0.77, and 0.84 for desorption.

Field studies (California) demonstrated calculated half lives of metribuzin (Sencor 75DF) in sandy loam of 128 days at Watsonville and 40 days at Fresno, with no leaching at 12 cm of parent compound or DADK.

Metribuzin can contaminate surface water via direct application and runoff. The extended half-life in soil is presumed to be due to the limited depth of penetration (about 1 mm) of adequate solar radiation. In clear, well mixed water the half-life is reduced substantially to < 5 hours, suggesting that aqueous contamination will be very transient.

E. Incidents:

80 Incidents are listed in the Agency database. In general these incidents are not positively associated with metribuzin, which is commonly applied in concert with other pesticides and/or fertilizers. The majority of the incidents are reported from direct human exposure. A single event, on September 16, 1992, is reported to have been associated with fish and bird deaths on a golf course (ornamental turf). Metribuzin is identified as a possible contaminant but not positively identified as the specific agent causing the incident.

F. Estimated and actual concentrations of Metribuzin in water:

An analysis of toxicity, whether acute or chronic, lethal or sublethal, must be combined with an analysis of how much chemical will be in the water, to determine risks to fish. Risk is a combination of exposure and toxicity. Even a very highly toxic chemical will not pose a risk if there is no exposure, or very minimal exposure relative to the toxicity. OPP uses a variety of chemical fate and transport data to develop “estimated environmental concentrations” (EECs) from a suite of established models. The GENEEC Expected Environmental Concentration program was used to predicted EEC’s for metribuzin. Data are derived from the 1998 RED for metribuzin.

The GENEEC model uses a few basic environmental fate chemical parameters and pesticide application rates to provide a rough estimate of the expected concentration of a chemical in the environment following treatment of ten hectares within which is a one hectare pond, two meters deep. The factors considered include adsorption to soil or sediment, soil incorporation, degradation prior to runoff, and degradation in water. The model also considers direct water application through spray drift (1 to 5% of the application rate). The fate parameters for metribuzin were: soil $_{KOA}$ = 41, solubility = 1,200 ppm, soil half - life = 106 days, and water proteolysis of 4.3 hours.

Table 3: Estimated Environmental Concentration of Metribuzin (1998 RED)

Site	Application Method	Application Rate (lbs a.i./A)	#Applications/ Interval (days)	Initial (Peak) EEC, (ppm)	21 Day EEC (ppm)	56 Day EEC (ppm)
Sugarcane	Aerial/Liquid	6.0	1	0.39	0.24	0.12
Sugarcane	Ground, unincorporated	4.0	2 (14)	0.07	0.13	0.10
Turf	ground, unincorporated	0.5	2 (7)	0.024	0.043	0.034
Peas	ground, incorporated	0.5	1	0/024	0.015	0.008

USGS surveys in 1989, 1990, 1994, and 1995 of mid-west surface water at periods of pre-application, post-application, and fall metribuzin use demonstrate that water concentrations were much less than 1 µg/L and generally below the detection limit of 0.05 µg/L. Sampling in the Mississippi Basin from May 1991 through February 1992 found metribuzin in samples above the detection limit of 0.05 µg/L. The maximum detected level was 0.38 µg/L, with only 5 other samples demonstrating levels > 0.2 µg/L. Sampling in 76 Midwestern reservoirs detected metribuzin in 36 of 732 samples above the detection limit of 0.05 µg/L.

G. Ecological Effects Toxicity Assessment:

i. Freshwater Fish: The minimum data required to establish the toxicity of Metribuzin technical (for formulation) to freshwater fish is from two species. The preferred species are rainbow trout (cold-water species) and bluegill sunfish (warm water species). Results of these tests are shown in Table 4.

Table 4: Freshwater Fish, Acute Toxicity (1998 RED)

Species	**% a.i.**	**LC_{50} (ppm)**	**Toxicity Class**
Oncorhynchus mykiss (rainbow trout)	90	42	Slightly Toxic
Oncorhynchus mykiss (rainbow trout)	70	99	Slightly Toxic
Oncorhynchus mykiss (rainbow trout)	97	77	Slightly Toxic
Oncorhynchus mykiss (rainbow trout)	50	147	practically non-toxic
Lepomis macrochirus (bluegill sunfish)	92	92	Slightly Toxic
Lepomis macrochirus (bluegill sunfish)	97	76	Slightly Toxic

Lepomis macrochirus (bluegill sunfish)	50	131	practically non-toxic

The values derived from these laboratory studies indicate that metribuzin is slightly toxic or practically non-toxic to freshwater fish.

ii. Freshwater Fish, Chronic: A freshwater fish early life-cycle test was required for Metribuzin because the exposure may be continuous, recurrent, or multiple, due to multiple applications. The results of this testing are shown in Table 5.

Table 5: Chronic Toxicity of Metribuzin, Early Life Cycle (1998 RED)

Species	**% a.i.**	**Effect**	**LOEC (ppm)**
Oncorhynchus mykiss (trout - static)	94	Growth	3

The LOEC was not determined since growth was affected at all levels tested. A freshwater fish life cycle test using the technical chemical was not required.

iii. Freshwater Invertebrates, Acute: The preferred species for testing Metribuzin toxicity in freshwater invertebrates is the Waterflea. Results of acute toxicity tests are shown in Table 6:

Table 6: Acute Toxicity of Metribuzin in Freshwater Invertebrates (1998 RED)

Species	**% a.i.**	**LC_{50}/EC_{50} (ppm)**	**Toxicity Class**
***Daphnia magna* (waterflea)**	**93**	**4.2**	**moderately toxic**
***Daphnia magna* (waterflea)**	**84**	**99**	**slightly toxic**

Metribuzin was classified as slightly to moderately toxic, on an acute basis, to freshwater invertebrates.

iv. Freshwater Invertebrates, Chronic Toxicity: A freshwater invertebrate, early life - cycle test is required for Metribuzin due to acute toxicity and potential for transport to water. Results of this testing are shown in Table 7.

Table 7: Chronic Toxicity of Metribuzin to Freshwater Invertebrates (1998 RED)

Species	**% a.i.**	**NOEC/ LOEC (ppm)**	**Effects**	**MATC (ppm)**
***Daphnia magna* (waterflea)**	**93**	**1.29 2.62**	**# of offspring length**	**1.84**

An NOEC was determined for the number of offspring and length. No NOEC was determined for weight, since there were effects at all levels tested.

v. Estuarine and Marine Fish, Acute Toxicity: Toxicity testing of Metribuzin in marine/estuarine fish was required. The preferred species is sheepshead minnow. Results of these tests are shown in Table 8.

Table 8: Acute Toxicity of Metribuzin in Marine/Estuarine Fish (1998 RED)

Species	% a.i.	96 hour LC50 (ppm)	Toxicity Class
Cyprinodon variegatus (sheepshead minnow)	94	85	slightly toxic

Metribuzin is classified as slightly toxic to marine/estuarine fish on an acute basis.

vi. Estuarine/Marine Fish, Chronic Toxicity: Estuarine/marine fish chronic toxicity, early life-cycle testing was not required for Metribuzin,

vii. Estuarine and Marine Invertebrate Acute Toxicity: Testing was performed to determine the acute toxicity of Metribuzin on marine/estuarine invertebrates. The preferred species are mysid shrimp and eastern oyster. Results are shown in Table 9.

Table 9: Acute Toxicity of Metribuzin to Marine/Estuarine Invertebrates (1998 RED)

Species	% a.i.	LC_{50}/EC_{50} (ppm)	Toxicity Class
Crassostrea virginica (oyster - shell deposition)	92	42	slightly toxic
Crassostrea virginica	92	41	slightly toxic
Crassostrea virginica	93	50	slightly toxic
Crassostrea virginica (oyster - shell deposition)	93	52	slightly toxic
Penaeus duorarum (pink shrimp)	92	48	slightly toxic

Metribuzin was found to be slightly toxic to marine/estuarine invertebrates.

viii. Estuarine/Marine Invertebrates, Chronic Toxicity: Testing for chronic toxicity of Metribuzin was not required.

The general characterization of Metribuzin toxicity for fresh water and marine/estuarine organisms is that it ranges from non-toxic to slightly toxic. A review of the Agency data base (TOXDATA) confirmed the general toxicity classifications appeared to be accurate.

H. Risk Quotients for Subject Species:

Based on toxicity and EEC data, risk quotients were calculated relevant to the T&E species of interest in California and Pacific Northwest ESUs. The results of these calculations are presented in Table 10. The EEC (Estimated Environmental Concentration) used to calculate the Risk Quotients (RQs) were derived from two distinct models. One assumed runoff to a 6' pond from the treated crop site (Model A). The second is based on expected runoff into a 6" body of water or wetland (Model B). The B model is used for Metribuzin only for evaluation of use in the treatment of Rights of Way. The highest application rate, 6 lbs a.i./A, is for surgarcane and not relavent to the species of concern for this report. The highest rates in the ESU's under review are for potatoes and alfalfa (0.82 lbs a.i./A) and these do not exceed the LOC for the species of concern.

Table 10: Risk Quotient Determinations for Freshwater Fish (1998 RED)

Site	Application Rate (lbs a.i./A)	EEC Initial (ppm)	EEC 56 Day	RQS (Chronic)	RQS (Acute)
Sugarcane/aerial	6	0.39	0.12	0.04	0.01
Sugarcane/ground	4	0.07	0.10	0.03	0.00
Turf	0.5	0.024	0.034	0.01	0.00
Peas/incorporated	0.5	0.024	.0008	0.00	0.00

These results indicate that use of metribuzin at registered rates does not exceed the Agency Level of Concern (LOC) for direct effects on endangered fish..

Table 11: Risk Quotient Determinations for Freshwater Invertebrates (1998 RED)

Site	Application Rate (lbs a.i./A)	EEC Initial (ppm)	EEC 21 Day	RQ (Chronic)	RQ (Acute)
Sugarcane/aerial	6	0.39	0.24	0.09	0.09
Sugarcane/ground	4	0.07	0.13	0.08	0.02
Turf	0.5	0.024	0.043	0.01	0.00
Peas/incorporated	0.5	0.024	0.015	0.01	0.01

These results indicate that the endangered species LOC is exceeded only for sugarcane. Since this site is not present in the ESU's being considered for this review, the LOC's for the species and areas addressed by this review are not exceeded. The risk to salmonids and steelhead are indirect and all scenarios do not exceed the RQ level of 0.1 for non-listed invertebrate species.

Table 12: Risk Quotients for Marine/Estuarine Animals (1998 RED)

Site	Application Rate (lbs a..i/A)	EEC Initial (ppm)	RQ (Acute)
Sugarcane/aerial	6	0.39	0.01
Sugarcane/ground	4	0.07	0.01
Turf	0.5	0.24	0.01
Peas/incorporated	0.5	0.024	0.01

The Agency LOC's are not exceeded for any of the modeled uses of metribuzin for marine/estuarine animals.

In the Agency consideration of the 1998 RED for metribuzin, efforts were made to evaluate the effects of metribuzin on non-target plants. The models used included sugarcane, peas, and tomato sites. The model basis was turnip, including emergence and vigor. The pattern of the species of concern for this report, which includes salmon and steelhead, suggests that these models are of little value. During early life stages these fish remain in the gravel base of the redds. Upon emergence they rapidly become pelagic, highly active, carnivora in fast moving water streams. The potential effects of non-target plant species are therefore not a concern for the species that are the subject of this review.

I. Discussion and Characterization of Risk Assessment.

Metribuzin is categorized as being slightly or practically non- toxic across the spectrum of species tested. It is somewhat persistent in the environment, but degrades rapidly (4.3 hours) in clear water that is well mixed and aerated. These conditions are, of course, typical for salmon and steelhead habitat. There are no exceedences for its use in crops grown in the ESU's of interest for this review..

J. Existing Protections: Currently the expected precautions regarding spray drift and personal safety measures are components of the label language for Metribuzin. In addition, specific measures are included regarding application rates based on crop types. These are a reflection of the tolerance levels of specific crops to the anti-photosynthesis effects of the chemical, it's primary mode of action.

K. Proposed Protections. Restrictions and rate reductions are proposed for sugarcane, the high use rate site for this chemical. These restrictions are not applicable to the salmon and steelhead ESU's addressed by this review.

3. Description of Pacific salmon and steelhead Evolutionarily Significant Units relative to Metribuzin use sites.

Metribuzin

1. Southern California Steelhead ESU

The Southern California steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final a year later (62FR43937-43954, August 18, 1997). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787). This ESU ranges from the Santa Maria River in San Luis Obispo County south to San Mateo Creek in San Diego County. Steelhead from this ESU may also occur in Santa Barbara, Ventura and Los Angeles counties, but this ESU apparently is no longer considered to be extant in Orange County (65FR79328-79336, December 19, 2000). Hydrologic units in this ESU are Cuyama (upstream barrier - Vaquero Dam), Santa Maria, San Antonio, Santa Ynez (upstream barrier - Bradbury Dam), Santa Barbara Coastal, Ventura (upstream barriers - Casitas Dam, Robles Dam, Matilja Dam, Vern Freeman Diversion Dam), Santa Clara (upstream barrier - Santa Felicia Dam), Calleguas, and Santa Monica Bay (upstream barrier - Rindge Dam). Counties comprising this ESU show a very high percentage of declining and extinct populations.

River entry ranges from early November through June, with peaks in January and February. Spawning primarily begins in January and continues through early June, with peak spawning in February and March.

Within San Diego County, the San Mateo Creek runs through Camp Pendleton Marine Base and into the Cleveland National Forest. While there are agricultural uses of pesticides in other parts of California within the range of this ESU, it would appear that there are no such uses in the vicinity of San Mateo Creek. Within Los Angeles County, this steelhead occurs in Malibu Creek and possibly, but unlikely, Topanga Creek. Neither of these creeks drain agricultural areas and there are no residential uses for this pesticide. There is a potential for steelhead in waters that drain agricultural areas in Ventura, Santa Barbara, and San Luis Obispo counties, but the small quantities of metribuzin used make effects highly unlikely. Usage of metribuzin in counties where this ESU occurs are presented in Table 12.

Table 12. Counties supporting the Southern California steelhead ESU

County	Site	Acres Treated	lbs a.i. Applied
Los Angeles	Landscape	NS	23
San Diego	Landscape	NS	34
San Diego	Potato	147	24
San Luis Obispo			None
Santa Barbara	Asparagus	704	974
Ventura	Landscape	NS	3

Ventura	Turf/Sod	43	11

The level of metribuzin use in the Southern California steelhead ESU is quite low (⇔1000 lbs) and this reported use rate will have no effect on endangered steelhead.

2. South Central California Steelhead ESU

The South Central California steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final, as threatened, a year later (62FR43937-43954, August 18, 1997). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787). This coastal steelhead ESU occupies rivers from the Pajaro River, Santa Cruz County, to (but not including) the Santa Maria River, San Luis Obispo County. Most rivers in this ESU drain the Santa Lucia Mountain Range, the southernmost unit of the California Coast Ranges (62FR43937-43954, August 18, 1997). River entry ranges from late November through March, with spawning occurring from January through April.

This ESU includes the Hydrologic units of Pajaro (upstream barriers - Chesbro Reservoir, North Fork Pachero Reservoir), Estrella, Salinas (upstream barriers - Nacimiento Reservoir, Salinas Dam, San Antonio Reservoir), Central Coastal (upstream barriers - Lopez Dam, Whale Rock Reservoir), Alisa-Elkhorn Sloughs, and Carmel. Counties of occurrence include Santa Cruz, San Benito, Monterey, and San Luis Obispo. There are agricultural areas in these counties, and these areas would be drained by waters where steelhead critical habitat occurs.

Table 13: Counties supporting the South Central California steelhead ESU

County	Site	Acres Treated	lbs. a.i. Applied
Monterey			None
San Benito	Asparagus	890	856
San Benito	Soil Fumigation	402	71
San Benito	Unknown	26	20
San Mateo			None
San Luis Obispo			None
Santa Clara	Landscape	NS	0.4
Santa Clara	Uncultivated Ag	136	71
Santa Cruz			None

.The level of metribuzin use in the South Central California steelhead ESU is quite low (⇔1000 lbs) and this reported use rate will have no effect on endangered steelhead.

3. Central California Coast Steelhead ESU

The Central California coast steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final, as threatened, a year later (62FR43937-43954, August 18, 1997). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787). This coastal steelhead ESU occupies California river basins from the Russian River, Sonoma County, to Aptos Creek, Santa Cruz County, (inclusive), and the drainage of San Francisco and San Pablo Bays eastward to the Napa River (inclusive), Napa County. The Sacramento-San Joaquin River Basin of the Central Valley of California is excluded. Steelhead in most tributary streams in San Francisco and San Pablo Bays appear to have been extirpated, whereas most coastal streams sampled in the central California coast region do contain steelhead.

Only winter steelhead are found in this ESU and those to the south. River entry ranges from October in the larger basins, late November in the smaller coastal basins, and continues through June. Steelhead spawning begins in November in the larger basins, December in the smaller coastal basins, and can continue through April with peak spawning generally in February and March. Hydrologic units in this ESU include Russian (upstream barriers - Coyote Dam, Warm Springs Dam), Bodega Bay, Suisun Bay, San Pablo Bay (upstream barriers - Phoenix Dam, San Pablo Dam), Coyote (upstream barriers - Almaden, Anderson, Calero, Guadelupe, Stevens Creek, and Vasona Reservoirs, Searsville Lake), San Francisco Bay (upstream barriers - Calveras Reservoir, Chabot Dam, Crystal Springs Reservoir, Del Valle Reservoir, San Antonio Reservoir), San Francisco Coastal South (upstream barrier - Pilarcitos Dam), and San Lorenzo-Soquel (upstream barrier - Newell Dam).

Counties of occurrence for this ESU are Santa Cruz, San Mateo, San Francisco, Marin, Sonoma, Mendocino, Napa, Alameda, Contra Costa, Solano, and Santa Clara counties. Usage of methamitophos in the counties where the Central California coast steelhead ESU is presented in Table 14.

Table 14: Counties supporting the Central California Coast steelhead ESU

County	Site	Acres Treated	lbs. a.i. Applied
Alameda			None
Contra Costa	Asparagus	1008	147
Contra Costa	Soil Fumigation	38	1
Contra Costa	Uncultivated Ag	593	222
Marin			None

Mendocino			None
Napa			None
San Francisco	Structural Pest Cont	NS	0.05
San Mateo			None
Santa Clara	Landscape	NS	0.4
Santa Clara	Uncultivated Ag	136	71
Santa Cruz			None
Solano	Landscape	NS	1
Solano	Research	NS	2
Solano	Tomato for Process	2019	358
Sonoma			None

The total application of metribuzin in the Central California Coast steelhead ESU is very modest and will have no effect on the species of concern.

4. California Central Valley Steelhead ESU

The California Central Valley steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final in 1998 (63FR 13347-13371, March 18, 1998). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787).

This ESU includes populations ranging from Shasta, Trinity, and Whiskeytown areas, along with other Sacramento River tributaries in the North, down the Central Valley along the San Joaquin River to and including the Merced River in the South, and then into San Pablo and San Francisco Bays. Counties at least partly within this area are Alameda, Amador, Butte, Calaveras, Colusa, Contra Costa, Glenn, Marin, Merced, Nevada, Placer, Sacramento, San Francisco, San Joaquin, San Mateo, Solano, Sonoma, Stanislaus, Sutter, Tehama, Tuloumne, Yolo, and Yuba. A large proportion of this area is heavily agricultural. Usage of metribuzin in counties where the California Central Valley steelhead ESU occurs is presented in Table 15.

Table 15: Counties supporting the California Central Valley steelhead ESU.

County	Site	Acres Treated	lbs. a.i. Applied
Alameda			None

Amador			None
Butte			None
Calaveras			None
Contra Costa	Asparagus	1008	147
Contra Costa	Soil Fumigation	38	1
Contra Costa	Uncultivated Ag	593	222
Glenn			None
Marin			None
Merced	Alfalfa	40	30
Merced	Corn, Sweet	105	52
Merced	Tomato	1139	572
Merced	Tomato for Process	211	89
Merced	Wheat	78	39
Nevada			None
Placer	Landscape	NS	2
Sacramento	Bean, Unspecified	149	37
Sacramento	Corn for Forage	40	6
Sacramento	Corn, Sweet	1047	74
Sacramento	Landscape	NS	3
Sacramento	Potato	37	14
Sacramento	Tomato	52	7
Sacramento	Tomato for Process	2721	570
San Joaquin	Alfalfa	35	52
San Joaquin	Asparagus	870	313
San Joaquin	Corn for Forage	440	59
San Joaquin	Landscape	NS	6
San Joaquin	Soil Fumigation	2227	1024

San Joaquin	Tomato	211	82
San Francisco	Structural Pest Cont	NS	0.05
San Mateo			None
Shasta	Alfalfa	770	521
Solano	Landscape	NS	1
Solano	Research	NS	2
Solano	Tomato for Process	2019	258
Sonoma			None
Stanislaus	Alfalfa	129	49
Stanislaus	Bean, Dry	195	41
Stanislaus	Bean, Succulent	195	11
Stanislaus	Landscape	45	16
Stanislaus	Rights of Way	NS	0.2
Stanislaus	Tomato	25	6
Stanislaus	Tomato for Process	3157	798
Stanislaus	Uncultivated Ag	603	140
Sutter	Alfalfa	30	44
Sutter	Corn for Forage	148	111
Sutter	Tomato for Process	2754	992
Tehama			None
Tuolumne			None
Yolo	Alfalfa	146	110
Yolo	Corn for Forage	822	110
Yolo	Research	NS	2
Yolo	Tomato	83	47
Yolo	Tomato for Process	11294	3824
Yolo	Uncultivated Ag	177	88

Yuba	Alfalfa	33	25

The quantity of metribuzin applied in the California Central Valley steelhead ESU is relatively modest. In combination with the essentially non-toxic character of the chemical, it will have no effect on endangered steelhead.

5. Northern California Steelhead ESU

The Northern California steelhead ESU was proposed for listing as threatened on February 11, 2000 (65FR6960-6975) and the listing was made final on June 7, 2000 (65FR36074-36094). Critical Habitat has not yet been officially established.

This Northern California coastal steelhead ESU occupies river basins from Redwood Creek in Humboldt County, CA to the Gualala River, inclusive, in Mendocino County, CA. River entry ranges from August through June and spawning from December through April, with peak spawning in January in the larger basins and in late February and March in the smaller coastal basins. The Northern California ESU has both winter and summer steelhead, including what is presently considered to be the southernmost population of summer steelhead, in the Middle Fork Eel River. Counties included appear to be Humboldt, Mendocino, Trinity, and Lake. Table 16 shows the use of metribuzin in the counties where the Northern California steelhead ESU occurs.

Table 16: Counties supporting the Northern California steelhead ESU

County	Site	Acres Treated	lbs. a.i. Applied
Humboldt			None
Lake			None
Mendocino			None
Trinity			None

Within the Northern California steelhead ESU, metribuzin is not applied. It will therefore have no effect on threatened steelhead.

6. Upper Columbia River steelhead ESU

The Upper Columbia River steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final a year later (62FR43937-43954, August 18, 1997). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787).

The Upper Columbia River steelhead ESU ranges from several northern rivers close to the Canadian border in central Washington (Okanogan and Chelan counties) to the mouth of the Columbia River. The primary area for spawning and growth through the smolt stage of this ESU is from the Yakima River in south Central Washington upstream. Hydrologic units within the spawning and rearing habitat of the Upper Columbia River steelhead ESU and their upstream barriers are Chief Joseph (upstream barrier - Chief Joseph Dam), Okanogan, Similkameen, Methow, Upper Columbia-Entiat, Wenatchee, Moses-Coulee, and Upper Columbia-Priest Rapids. Within the spawning and rearing areas, counties are Chelan, Douglas, Okanogan, Grant, Benton, Franklin, Kittitas, and Yakima, all in Washington.

Areas downstream from the Yakima River are used for migration. Additional counties through which the ESU migrates are Walla Walla, Klickitat, Skamania, Clark, Columbia, Cowlitz, Wahkiakum, and Pacific, Washington; and Gilliam, Morrow, Sherman, Umatilla, Wasco, Hood River, Multnomah, Columbia, and Clatsop, Oregon.

Tables 17 and 18 show the cropping information and maximum potential metribuzin use for Washington counties where the Upper Columbia River steelhead ESU is located and for the Oregon and Washington counties where this ESU migrates.

Table 17. Spawning and rearing areas supporting the Upper Columbia River steelhead ESU

State	County	Site	Acres Treated	lbs a.i. Applied
WA	Benton	Wheat	917	183
WA	Benton	Potato	18423	9212
WA	Benton	Asparagus	236	260
WA	Benton	Alfalfa	119	60
WA	Benton	Tomato	1	1
WA	Franklin	Wheat	767	153
WA	Franklin	Corn	34	7
WA	Franklin	Potato	23609	11804
WA	Franklin	Dry Peas	1198	90
WA	Franklin	Green Peas	108	22
WA	Franklin	Alfalfa	639	320
WA	Franklin	Hay	4	2
WA	Franklin	Asparagus	4822	5304

WA	Franklin	Carrot	357	71
WA	Franklin	Tomato	1	1
WA	Grant	Wheat	1425	285
WA	Grant	Corn	90	18
WA	Grant	Barley	9	1
WA	Grant	Potato	29214	14607
WA	Grant	Dry Peas	2936	801
WA	Grant	Green Peas	1796	359
WA	Grant	Alfalfa	7	4
WA	Grant	Hay	12	5
WA	Grant	Asparagus	526	579
WA	Grant	Carrot	201	42
WA	Grant	Tomato	2	1
WA	Okanogan	Wheat	59	12
WA	Okanogan	Alfalfa	197	99
WA	Okanogan	Hay	15	6
WA	Yakima	Wheat	353	71
WA	Yakima	Corn	38	8
WA	Yakima	Potato	1273	637
WA	Yakima	Alfalfa	205	153
WA	Yakima	Hay	5	2
WA	Yakima	Asparagus	3939	4333
WA	Yakima	Tomato	85	30
WA	Yakima	Green Peas	70	14

Table 18: Oregon and Washington counties that are migration corridors for the Upper Columbia River steelhead ESU.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Clatsop			None
OR	Columbia	Wheat	13	3
OR	Columbia	Alfalfa	2	2
OR	Columbia	Hay	2	1
OR	Gilliam	Wheat	669	134
OR	Gilliam	Barley	13	8
OR	Gilliam	Alfalfa	22	13
OR	Hood River	Alfalfa	4	2
OR	Morrow	Wheat	1170	234
OR	Morrow	Barley	3	2
OR	Morrow	Potato	11240	5620
OR	Morrow	Alfalfa	200	120
OR	Morrow	Green Peas	73	15
OR	Morrow	Corn	14	3
OR	Multnomah	Wheat	12	2
OR	Multnomah	Potato	222	111
OR	Multnomah	Alfalfa	4	2
OR	Multnomah	Green Peas	62	12
OR	Multnomah	Corn	6	1
OR	Multnomah	Tomato	6	3
OR	Sherman			None
OR	Umatilla	Wheat	1843	360
OR	Umatilla	Barley	16	10
OR	Umatilla	Dry Peas	1779	321
OR	Umatilla	Green Peas	2817	563
OR	Umatilla	Potato	9902	4951

OR	Umatilla	Alfalfa	216	120
OR	Umatilla	Hay	3	1
OR	Umatilla	Corn	12	2
OR	Umatilla	Tomato	8	4
OR	Wasco	Alfalfa	65	39
WA	Clark	Hay	38	15
WA	Cowlitz	Alfalfa	1	1
WA	Cowlitz	Hay	7	3
WA	Cowletz	Green Peas	108	22
WA	Klikitat	Wheat	283	57
WA	Klikitat	Barley	8	1
WA	Klikitat	Alfalfa	256	128
WA	Klikitat	Hay	13	5
WA	Klikitat	Tomato	3	2
WA	Pacific	Alfalfa	1	1
WA	Pacific	Hay	7	3
WA	Skamannia	Alfalfa	2	1
WA	Wahkiakum			None
WA	Walla Walla	Corn	20	4
WA	Walla Walla	Wheat	1627	325
WA	Walla Walla	Potato	5439	2720
WA	Walla Walla	Dry Peas	3558	1007
WA	Walla Walla	Alfalfa	106	33
WA	Walla Walla	Barley	23	2
WA	Walla Walla	Hay	13	5
WA	Walla Walla	Asparagus	791	870

Major use sites for metribuzin are limited to Franklin and Grant counties. Although a significant use of the chemical is noted, the low level of toxicity and short half-life in clear, aerated waters typical of steelhead habit indicate that the registered uses of metribuzin will have no effect on the Upper Columbia river Steelhead ESU.

7. Snake River Basin steelhead ESU

The Snake River Basin steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final a year later (62FR43937-43954, August 18, 1997). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787).

Spawning and early growth areas of this ESU consist of all areas upstream from the confluence of the Snake River and the Columbia River as far as fish passage is possible. Hells Canyon Dam on the Snake River and Dworshak Dam on the Clearwater River, along with Napias Creek Falls near Salmon, Idaho, are named as impassable barriers. These areas include the counties of Wallowa, Baker, Union, and Umatilla (northeastern part) in Oregon; Asotin, Garfield, Columbia, Whitman, Franklin, and Walla Walla in Washington; and Adams, Idaho, Nez Perce, Blaine, Custer, Lemhi, Boise, Valley, Lewis, Clearwater, and Latah in Idaho. Baker County, Oregon, which has a tiny fragment of the Imnaha River watershed was excluded. While a small part of Rock Creek that extends into Baker County, this occurs at 7200 feet in the mountains (partly in a wilderness area) and is of no significance with respect to metribuzin use in agricultural areas. Similarly excluded are the Upper Grande Ronde watershed tributaries (e.g., Looking Glass and Cabin Creeks) that are barely into higher elevation forested areas of Umatilla County. However, crop areas of Umatilla County are considered in the migratory routes. In Idaho, Blaine and Boise counties technically have waters that are part of the steelhead ESU, but again, these are tiny areas which occur in the Sawtooth National Recreation Area and/or National Forest lands. They have been excluded because they are not relevant to use of metribuzin. The agricultural areas of Valley County, Idaho, appear to be primarily associated with the Palette River watershed, but there is enough of the Salmon River watershed in this county that it was not able to exclude it.

Critical Habitat also includes the migratory corridors of the Columbia River from the confluence of the Snake River to the Pacific Ocean. Additional counties in the migratory corridors are Umatilla, Gilliam, Morrow, Sherman, Wasco, Hood River, Multnomah, Columbia, and Clatsop in Oregon; and Benton, Klickitat, Skamania, Clark, Cowlitz, Wahkiakum, and Pacific in Washington.

Tables 19 and 20 show the cropping information for the Pacific Northwest counties where the Snake River Basin steelhead ESU is located and for the Oregon and Washington counties where this ESU migrates.

Table 19: Rearing/spawning areas supporting the Snake River Basin steelhead ESU .

State	County	Site	Acres Treated	lbs a.i. Applied
ID	Adams			None
ID	Clearwater	Dry Peas	428	128
ID	Clearwater	Alfalfa	24	14
ID	Custer	Barley	29	17
ID	Custer	Potato	220	132
ID	Idaho	Wheat	436	87
ID	Idaho	Barley	26	16
ID	Idaho	Dry Peas	895	269
ID	Idaho	Alfalfa	182	109
ID	Idaho	Hay	6	2
ID	Latah	Wheat	635	127
ID	Latah	Barley	19	11
ID	Latah	Dry Beans	15134	4540
ID	Lemhi	Hay	3	1
ID	Lemhi	Alfalfa	226	136
ID	Idaho	Alfalfa	65	39
ID	Idaho	Hay	6	2
ID	Nez Perce	Wheat	630	126
ID	Nez Perce	Barley	21	13
ID	Nez Perce	Dry Peas	264	79
ID	Nez Perce	Alfalfa	56	34
ID	Valley	Wheat	5	1
ID	Valley	Alfalfa	14	8
ID	Valley	Potato	12479	6240
OR	Union	Wheat	1426	285
OR	Union	Potato	436	218

OR	Union	Alfalfa	205	123
OR	Union	Hay	2	1
OR	Wallowa	Wheat	255	51
OR	Willowa	Barley	9	1
OR	Willowa	Alfalfa	164	98
OR	Willowa	Hay	3	1
WA	Adams	Corn	16	3
WA	Adams	Wheat	2127	425
WA	Adams	Potato	18423	9212
WA	Adams	Barley	10	1
WA	Adams	Alfalfa	210	102
WA	Adams	Dry Peas	1198	359
WA	Adams	Asparagus	236	260
WA	Adams	Hay	11	4
WA	Asotin	Wheat	148	30
WA	Asotin	Barley	10	1
WA	Asotin	Alfalfa	15	8
WA	Asotin	Hay	8	3
WA	Columbia	Barley	18	2
WA	Columbia	Dry Peas	3777	1133
WA	Columbia	Alfalfa	16	8
WA	Columbia	Hay	2	1
WA	Franklin	Wheat	767	153
WA	Franklin	Corn	34	7
WA	Franklin	Potato	23609	11804
WA	Franklin	Dry Peas	1198	90
WA	Franklin	Green Peas	80	16

WA	Franklin	Alfalfa	639	320
WA	Franklin	Hay	4	2
WA	Franklin	Asparagus	4822	5304
WA	Franklin	Carrot	357	71
WA	Franklin	Tomato	1	1
WA	Garfield	Wheat	502	100
WA	Garfield	Barley	30	3
WA	Garfield	Alfalfa	7	4
WA	Garfield	Hay	2	1
WA	Walla Walla	Potato	5439	2720
WA	Walla Walla	Dry Peas	3558	1007
WA	Walla Walla	Alfalfa	106	33
WA	Walla Walla	Barley	23	2
WA	Walla Walla	Hay	13	5
WA	Walla Walla	Asparagus	791	870

Table 20. Washington and Oregon counties through which the Snake River Basin steelhead ESU migrates

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Clatsop			None
OR	Columbia	Wheat	13	3
OR	Columbia	Alfalfa	2	2
OR	Columbia	Hay	2	1
OR	Gilliam	Wheat	669	134
OR	Gilliam	Barley	13	8
OR	Gilliam	Alfalfa	22	13
OR	Hood River	Alfalfa	4	2

OR	Morrow	Wheat	1170	234
OR	Morrow	Barley	3	2
OR	Morrow	Potato	11240	5620
OR	Morrow	Alfalfa	200	120
OR	Morrow	Green Peas	73	15
OR	Morrow	Corn	14	3
OR	Multnomah	Wheat	12	2
OR	Multnomah	Potato	222	111
OR	Multnomah	Alfalfa	4	2
OR	Multnomah	Green Peas	62	12
OR	Multnomah	Corn	6	1
OR	Multnomah	Tomato	6	3
OR	Sherman			None
OR	Umatilla	Wheat	1843	360
OR	Umatilla	Barley	16	10
OR	Umatilla	Dry Peas	1779	321
OR	Umatilla	Green Peas	2817	563
OR	Umatilla	Potato	9902	4951
OR	Umatilla	Alfalfa	216	120
OR	Umatilla	Hay	3	1
OR	Umatilla	Corn	12	2
OR	Umatilla	Tomato	8	4
OR	Wasco	Alfalfa	65	39
WA	Benton	Wheat	917	183
WA	Benton	Potato	18423	9212
WA	Benton	Asparagus	236	260
WA	Benton	Alfalfa	119	60

WA	Benton	Tomato	1	1
WA	Clark	Hay	38	15
WA	Clark	Tomato	3	2
WA	Cowlitz	Alfalfa	1	1
WA	Cowletz	Hay	7	3
WA	Cowletz	Green Peas	108	22
WA	Klikitat	Wheat	283	57
WA	Klikitat	Barley	8	1
WA	Klikitat	Alfalfa	256	128
WA	Klikitat	Hay	13	5
WA	Klikitat	Tomato	3	2
WA	Wahkiakum			None
WA	Pacific	Alfalfa	1	1
WA	Pacific	Hay	7	3
WA	Skamania	Alfalfa	2	1
WA	Walla Walla	Potato	5439	2720
WA	Walla Walla	Dry Peas	3558	1007
WA	Walla Walla	Alfalfa	106	33
WA	Walla Walla	Barley	23	2
WA	Walla Walla	Hay	13	5
WA	Walla Walla	Asparagus	791	870

There is moderate use of metribuzin in the Snake River Basin Steelhead ESU. The observation of EFED that this chemical is minimally toxic to aquatic animals and the general paucity of susceptible plants in the steelhead habitat suggests the registered use of the chemical will have no effect on the species of concern.

8 Upper Willamette River steelhead ESU

The Upper Willamette River steelhead ESU was proposed for listing as threatened on March 10, 1998 (63FR11798-11809) and the listing was made final a year later (64FR14517-

14528, March 25, 1999). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787). Only naturally spawned, winter steelhead trout are included as part of this ESU; where distinguishable, summer-run steelhead trout are not included.

Spawning and rearing areas are river reaches accessible to listed steelhead in the Willamette River and its tributaries above Willamette Falls up through the Calapooia River. This includes most of Benton, Linn, Polk, Clackamas, Marion, Yamhill, and Washington counties, and small parts of Lincoln and Tillamook counties. However, the latter two counties are small portions in forested areas where metribuzin would not be used, and these counties are excluded from my analysis. While the Willamette River extends upstream into Lane County, the final Critical Habitat Notice does not include the Willamette River (mainstream, Coastal and Middle forks) in Lane County or the MacKenzie River and other tributaries in this county that were in the proposed Critical Habitat.

Hydrologic units where spawning and rearing occur are Upper Willamette, North Centime (upstream barrier - Big Cliff Dam), South Centime (upstream barrier - Green Peter Dam), Middle Willamette, Yamhill, Molalla-Pudding, and Tualatin.

The areas below Willamette Falls and downstream in the Columbia River are considered migration corridors, and include Multnomah, Columbia and Clatsop counties, Oregon, and Clark, Cowlitz, Wahkiakum, and Pacific counties, Washington.

Tables 21 and 22 show the cropping information for Oregon counties where the Upper Willamette River steelhead ESU is located and for the Oregon and Washington counties where this ESU migrates.

Table 21: Spawning and rearing habitat of the Upper Willamette River steelhead ESU.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Benton	Alfalfa	5	3
OR	Benton	Hay	2	1
OR	Linn	Alfalfa	23	13
OR	Linn	Hay	13	5
OR	Linn	Corn	27	5
OR	Linn	Tomato	2	1
OR	Polk	Wheat	66	13
OR	Polk	Alfalfa	7	4
OR	Polk	Hay	5	2

OR	Polk	Corn	13	3
OR	Polk	Tomato	2	1
OR	Clackamus	Alfalfa	10	6
OR	Clackamus	Hay	5	2
OR	Clackamus	Green Peas	10	2
OR	Clackamus	Tomato	6	3
OR	Clackamus	Corn	5	1
OR	Marion	Wheat	72	14
OR	Marion	Alfalfa	12	7
OR	Marion	Hay	4	2
OR	Marion	Carrot	8	2
OR	Marion	Corn	67	13
OR	Marion	Tomato	53	
OR	Marion	Green Peas	69	14
OR	Yamill	Barley	38	23
OR	Yamill	Alfalfa	21	13
OR	Yamill	Hay	4	2
OR	Yamill	Corn	25	5
OR	Yamill	Tomato	2	1
OR	Yamhill	Wheat	98	20
OR	Washington	Wheat	119	24
OR	Washington	Alfalfa	15	6
OR	Washington	Hay	3	1
OR	Washington	Tomato	4	2

Table 22. Oregon and Washington counties that are part of the migration corridors of the Upper Willamette River steelhead ESU.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Multnomah	Wheat	12	2
OR	Multnomah	Potato	222	111
OR	Multnomah	Alfalfa	4	2
OR	Multnomah	Green Peas	62	12
OR	Multnomah	Corn	6	1
OR	Multnomah	Tomato	6	3
OR	Clatsop			None
OR	Columbia	Wheat	13	3
OR	Columbia	Alfalfa	2	2
OR	Columbia	Hay	2	1
WA	Clark	Hay	38	15
WA	Clark	Tomato	3	2
WA	Clark	Alfalfa	1	1
WA	Clark	Green Peas	108	22
WA	Cowlitz	Hay	7	3
WA	Cowletz	Alfalfa	1	1
WA	Cowletz	Green Peas	108	22
WA	Wahkiakum			None
WA	Pacific	Alfalfa	1	1
WA	Pacific	Hay	7	3

Use of metribuzin in the Upper Willamette River Steelhead ESU is quite modest, and will have no effect on the species of concern.

9. Lower Columbia River steelhead ESU

The Lower Columbia River steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final a year later (62FR43937-43954, August 18, 1997). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on

February 16, 2000 (65FR7764-7787).

This ESU includes all tributaries from the lower Willamette River (below Willamette Falls) to Hood River in Oregon, and from the Cowlitz River up to the Wind River in Washington. These tributaries would provide the spawning and presumably the growth areas for the young steelhead. It is not clear if the young and growing steelhead in the tributaries would use the nearby mainstem of the Columbia prior to downstream migration. If not, the spawning and rearing habitat would occur in the counties of Hood River, Clackamas, and Multnomah counties in Oregon, and Skamania, Clark, and Cowlitz counties in Washington. Tributaries of the extreme lower Columbia River, e.g., Grays River in Pacific and Wahkiakum counties, Washington and John Day River in Clatsop county, Oregon, are not discussed in the Critical Habitat FRNs; because they are not "between" the specified tributaries, they do not appear part of the spawning and rearing habitat for this steelhead ESU. The mainstem of the Columbia River from the mouth to Hood River constitutes the migration corridor. This would additionally include Columbia and Clatsop counties, Oregon, and Pacific and Wahkiakum counties, Washington.

Hydrologic units for this ESU are Middle Columbia-Hood, Lower Columbia-Sandy (upstream barrier - Bull Run Dam 2), Lewis (upstream barrier - Merlin Dam), Lower Columbia-Clatskanie, Lower Cowlitz, Lower Columbia, Clackamas, and Lower Willamette.

Tables 23 and 24 show the cropping information for Oregon and Washington counties where the Lower Columbia River steelhead ESU is located and for the Oregon and Washington counties where this ESU migrates.

Table 23. Spawning/rearing areas for the Lower Columbia steelhead ESU

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Clackamus	Alfalfa	10	6
OR	Clackamus	Hay	5	2
OR	Clackamus	Green Peas	10	2
OR	Clackamus	Tomato	6	3
OR	Clackamus	Corn	5	1
OR	Hood River	Alfalfa	4	2
OR	Multnomah	Wheat	12	2
OR	Multnomah	Potato	222	111
OR	Multnomah	Alfalfa	4	2
OR	Multnomah	Green Peas	62	12

OR	Multnomah	Corn	6	1
OR	Multnomah	Tomato	6	3
WA	Clark	Hay	38	15
WA	Clark	Tomato	3	2
WA	Cowlitz	Hay	73	3
WA	Cowletz	Alfalfa	1	1
WA	Cowletz	Green Peas	108	22
WA	Skamania	Alfalfa	2	1

Table 24: Migratory corridors for the Lower Columbia River Steelhead ESU.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Clatsop			None
WA	Pacific	Alfalfa	1	1
WA	Pacific	Hay	7	3
WA	Wahkiakum			None

Use of metribuzin in the Lower Columbia River Steelhead ESU is very modest, and will have no effect on the species of concern.

10. Middle Columbia River Steelhead ESU

The Middle Columbia River steelhead ESU was proposed for listing as threatened on March 10, 1998 (63FR11798-11809) and the listing was made final a year later (64FR14517-14528, March 25, 1999). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787).

This steelhead ESU occupies "the Columbia River Basin and tributaries from above the Wind River in Washington and the Hood River in Oregon (exclusive), upstream to, and including, the Yakima River, in Washington." The Critical Habitat designation indicates the downstream boundary of the ESU to be Mosier Creek in Wasco County, Oregon; this is consistent with Hood River being "excluded" in the listing notice. No downstream boundary is listed for the Washington side of the Columbia River, but if Wind River is part of the Lower Columbia steelhead ESU, it appears that Collins Creek, Skamania County, Washington would be the last stream down river in the Middle Columbia River ESU. Dog Creek may also be part of the ESU, but White Salmon River certainly is, since the Condit Dam is mentioned as an upstream barrier. There is limited data on the status of the Dog and Collins creeks. The only other upstream barrier, in addition to Condit Dam on the White Salmon River is the Pelton Dam on the Deschutes River. As an upstream barrier, this dam would preclude steelhead from reaching the Metolius and Crooked Rivers as well the upper Deschutes River and its tributaries.

In the John Day River watershed, I have excluded Harney County, Oregon because there is only a tiny amount of the John Day River and several tributary creeks (e.g., Utley, Bear Cougar creeks) which get into high elevation areas (approximately 1700M and higher) of northern Harney County where there are no crops grown. Similarly, the Umatilla River and Walla Walla River get barely into Union County OR, and the Walla Walla River even gets into a tiny piece of Wallowa County, Oregon. But again, these are high elevation areas where crops are not grown, and are excluded counties for this analysis.

The Oregon counties then that appear to have spawning and rearing habitat are Gilliam, Morrow, Umatilla, Sherman, Wasco, Crook, Grant, Wheeler, and Jefferson counties. Hood River, Multnomah, Columbia, and Clatsop counties in Oregon provide migratory habitat. Washington counties providing spawning and rearing habitat would be Benton, Columbia, Franklin, Kittitas, Klickitat, Skamania, Walla Walla, and Yakima, although only a small portion of Franklin County between the Snake River and the Yakima River is included in this ESU. Skamania, Clark, Cowlitz, Wahkiakum, and Pacific Counties in Washington provide migratory corridors.

Tables 25 and 26 show the cropping information for Oregon and Washington counties where the Middle Columbia River steelhead ESU is located and for the Oregon and Washington counties where this ESU migrates.

Table 25. Spawning/Rearing areas for the Middle Columbia Steelhead ESU

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Crook			None
OR	Gilliam	Wheat	669	134
OR	Gilliam	Barley	13	8
OR	Gilliam	Alfalfa	22	13
OR	Jefferson	Barley	1	1
OR	Jefferson	Alfalfa	99	59
OR	Morrow	Wheat	1170	234
OR	Morrow	Barley	3	2
OR	Morrow	Potato	11240	5620

OR	Morrow	Alfalfa	200	120
OR	Morrow	Green Peas	73	15
OR	Morrow	Corn	14	3
OR	Sherman			None
OR	Umatilla	Wheat	1843	360
OR	Umatilla	Barley	16	10
OR	Umatilla	Dry Peas	1779	321
OR	Umatilla	Green Peas	2817	563
OR	Umatilla	Potato	9902	4951
OR	Umatilla	Alfalfa	216	120
OR	Umatilla	Hay	3	1
OR	Umatilla	Corn	12	2
OR	Umatilla	Tomato	8	4
OR	Wasco	Alfalfa	65	39
OR	Wheeler	Alfalfa	30	8
WA	Benton	Wheat	917	183
WA	Benton	Potato	18423	9212
WA	Benton	Asparagus	236	260
WA	Benton	Alfalfa	119	60
WA	Benton	Tomato	1	1
WA	Columbia	Barley	18	2
WA	Columbia	Dry Peas	3777	1133
WA	Columbia	Alfalfa	16	8
WA	Columbia	Hay	2	1
WA	Franklin	Wheat	767	153
WA	Franklin	Corn	34	7
WA	Franklin	Potato	23609	11804

WA	Franklin	Dry Peas	1198	90
WA	Franklin	Green Peas	80	16
WA	Franklin	Alfalfa	639	320
WA	Franklin	Hay	4	2
WA	Franklin	Asparagus	4822	5304
WA	Franklin	Carrot	357	71
WA	Franklin	Tomato	1	1
WA	Grant	Wheat	1425	285
WA	Grant	Corn	90	18
WA	Grant	Barley	9	1
WA	Grant	Potato	29214	14607
WA	Grant	Dry Peas	2936	801
WA	Grant	Green Peas	1796	359
WA	Grant	Alfalfa	7	4
WA	Grant	Hay	12	5
WA	Grant	Asparagus	526	579
WA	Grant	Carrot	201	42
WA	Grant	Tomato	2	1
WA	Kittitas	Wheat	27	7
WA	Kittitas	Potato	292	145
WA	Kittitas	Alfalfa	77	39
WA	Kittitas	Hay	13	5
WA	Skamania	Alfalfa	2	1
WA	Walla Walla	Potato	5439	2720
WA	Walla Walla	Dry Peas	3558	1007
WA	Walla Walla	Alfalfa	106	33
WA	Walla Walla	Barley	23	2

WA	Walla Walla	Hay	13	5
WA	Walla Walla	Asparagus	791	870
WA	Yakima	Wheat	353	71
WA	Yakima	Corn	38	8
WA	Yakima	Potato	1273	637
WA	Yakima	Alfalfa	205	153
WA	Yakima	Hay	5	2
WA	Yakima	Asparagus	3939	4333
WA	Yakima	Tomato	85	30
WA	Yakima	Green Peas	70	14

Table 26. Washington and Oregon counties through which the Middle Columbia River steelhead ESU migrates

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Clatsop			None
OR	Columbia	Wheat	13	3
OR	Columbia	Alfalfa	2	2
OR	Columbia	Hay	2	1
OR	Hood River	Alfalfa	3	2
OR	Multnomah	Wheat	12	2
OR	Multnomah	Potato	222	111
OR	Multnomah	Alfalfa	4	2
OR	Multnomah	Green Peas	62	12
OR	Multnomah	Corn	6	1
OR	Multnomah	Tomato	6	3
WA	Clark	Hay	38	15
WA	Clark	Tomato	3	2

WA	Cowlitz	Hay	73	3
WA	Cowletz	Alfalfa	1	1
WA	Cowletz	Green Peas	108	22
WA	Pacific	Alfalfa	1	1
WA	Pacific	Hay	7	3
WA	Wahkiakum			None

There is moderate use of metribuzin in the Middle Columbia Steelhead ESU, however the low toxicity and short half-life of the chemical indicate it will have no effect on the listed species of concern.

B. Chinook salmon

Chinook salmon *(Oncorhynchus tshawytscha)* is the largest salmon species; adults weighing over 120 pounds have been caught in North American waters. Like other Pacific salmon, chinook salmon are anadromous and die after spawning.

Juvenile stream- and ocean-type chinook salmon have adapted to different ecological niches. Ocean-type chinook salmon, commonly found in coastal streams, tend to utilize estuaries and coastal areas more extensively for juvenile rearing. They typically migrate to sea within the first three months of emergence and spend their ocean life in coastal waters. Summer and fall runs predominate for ocean-type chinook. Stream-type chinook are found most commonly in headwater streams and are much more dependent on freshwater stream ecosystems because of their extended residence in these areas. They often have extensive offshore migrations before returning to their natal streams in the spring or summer months. Stream-type smolts are much larger than their younger ocean-type counterparts and are therefore able to move offshore relatively quickly.

Coast-wide, chinook salmon typically remain at sea for 2 to 4 years, with the exception of a small proportion of yearling males (called jack salmon) which mature in freshwater or return after 2 or 3 months in salt water. Ocean-type chinook salmon tend to migrate along the coast, while stream-type chinook salmon are found far from the coast in the central North Pacific. They return to their natal streams with a high degree of fidelity. Seasonal ‘‘runs’’ (i.e., spring, summer, fall, or winter), which may be related to local temperature and water flow regimes, have been identified on the basis of when adult chinook salmon enter freshwater to begin their spawning migration. Egg deposition must occur at a time to ensure that fry emerge during the following spring when the river or estuarine productivity is sufficient for juvenile survival and growth.

Adult female chinook will prepare a spawning bed, called a redds, in a stream area with suitable gravel composition, water depth and velocity. After laying eggs in a redds, adult chinook will guard the redds from 4 to 25 days before dying. Chinook salmon eggs will hatch, depending upon water temperatures, between 90 to 150 days after deposition. Juvenile chinook may spend from 3 months to 2 years in freshwater after emergence and before migrating to estuarine areas as smolts, and then into the ocean to feed and mature. Historically, chinook salmon ranged as far south as the Ventura River, California, and their northern extent reaches the Russian Far East.

1. Sacramento River Winter-run Chinook Salmon ESU

The Sacramento River Winter-run chinook was emergency listed as threatened with critical habitat designated in 1989 (54FR32085-32088, August 4, 1989). This emergency listing provided interim protection and was followed by (1) a proposed rule to list the winter-run on March 20, 1990, (2) a second emergency rule on April 20, 1990, and (3) a formal listing on November 20, 1990 (59FR440-441, January 4, 1994). A somewhat expanded critical habitat was proposed in 1992 (57FR36626-36632, August 14, 1992) and made final in 1993 (58FR33212-33219, June 16, 1993). In 1994, the winter-run was reclassified as endangered because of significant declines and continued threats (59FR440-441, January 4, 1994).

Critical Habitat has been designated to include the Sacramento River from Keswick Dam, Shasta County (river mile 302) to Chipps Island (river mile 0) at the west end of the Sacramento-San Joaquin delta, and then westward through most of the fresh or estuarine waters, north of the Oakland Bay Bridge, to the ocean. Estuarine sloughs in San Pablo and San Francisco bays are excluded (58FR33212-33219, June 16, 1993).

Table 27 shows the metribuzin usage in California counties supporting the Sacramento River winter-run chinook salmon ESU. Use of metribuzin in counties with the Sacramento River winter-run Chinook salmon ESU. Spawning areas are primarily in Shasta and Tehama counties above the Red Bluff diversion dam.

Table 27: California counties supporting the Sacramento River, winter-run chinook ESU.

County	Site	Acres Treated	lbs a.i. Applied
Alameda			None
Butte			None
Contra Costa	Asparagus	1008	141
Contra Costa	Soil Fumigation	39	1
Contra Costa	Uncultivated Ag	593	222
Glenn			None
Marin			None
Sacramento	Bean, Unspecified	149	37

Sacramento	Corn for Forage	40	6
Sacramento	Corn, Sweet	1047	74
Sacramento	Landscape	NS	3
Sacramento	Potato	37	14
Sacramento	Tomato	52	7
Sacramento	Tomato for Process	2721	570
San Francisco	Structural Pest Cont	NS	0.05
San Mateo			None
Shasta	Alfalfa	770	521
Solano	Landscape	NS	1
Solano	Research	NS	2
Solano	Tomato for Process	2019	258
Sonoma			None
Sutter	Alfalfa	44	30
Sutter	Corn for Forage	148	111
Sutter	Tomato for Process	2754	992
Yolo	Alfalfa	146	110
Yolo	Corn for Forage	822	110
Yolo	Research	NS	2
Yolo	Tomato	83	47
Yolo	Tomato for Process	11294	3824
Yolo	Uncultivated Ag	177	88
Yuba	Alfalfa	33	25

Use of metribuzin within the Sacramento River, winter-run chinook salmon ESU is relatively low. Combined with the essentially non-toxic character of this chemical, it will have no effect on endangered chinook salmon.

2. Snake River Fall-run Chinook Salmon ESU

The Snake River fall-run chinook salmon ESU was proposed as threatened in 1991 (56FR29547-29552, June 27, 1991) and listed about a year later (57FR14653-14663, April 22, 1992). Critical habitat was designated on December 28, 1993 (58FR68543-68554) to include all tributaries of the Snake and Salmon Rivers accessible to Snake River fall-run chinook salmon, except reaches above impassable natural falls and Dworshak and Hells Canyon Dams. The Clearwater River and Palouse River watersheds are included for the fall-run ESU, but not for the spring/summer run. This chinook ESU was proposed for reclassification on December 28, 1994 (59FR66784-57403) as endangered because of critically low levels, based on very sparse runs. However, because of increased runs in the subsequent year, this proposed reclassification was withdrawn (63FR1807-1811, January 12, 1998).

In 1998, NMFS proposed to revise the Snake River fall-run chinook to include those stocks using the Deschutes River (63FR11482-11520, March 9, 1998). The John Day, Umatilla, and Walla Walla Rivers would be included; however, fall-run chinook in these rivers are believed to have been extirpated. It appears that this proposal has yet to be finalized. I have not included these counties here; however, I would note that the Middle Columbia River steelhead ESU encompasses these basins, and crop information is presented in that section of this analysis.

Hydrologic units with spawning and rearing habitat for this fall-run chinook are the Clearwater, Hells Canyon, Imnaha, Lower Grande Ronde, Lower North Fork Clearwater, Lower Salmon, Lower Snake-Asotin, Lower Snake-Tucannon, and Palouse. These units are in Baker, Umatilla, Wallowa, and Union counties in Oregon; Adams, Asotin, Columbia, Franklin, Garfield, Lincoln, Spokane, Walla Walla, and Whitman counties in Washington; and Adams, Benewah, Clearwater, Idaho, Latah, Lewis, Nez Perce, Shoshone, and Valley counties in Idaho. Custer and Lemhi counties in Idaho are not listed as part of the fall-run ESU, although they are included for the spring/summer-run ESU. Because only high elevation forested areas of Baker and Umatilla counties in Oregon are in the spawning and rearing areas for this fall-run chinook, they were excluded them from consideration because metribuzin would not be used in these areas.

Table 28 show the cropping information for Pacific Northwest counties where the Snake River fall-run chinook salmon ESU is located. Migration corridors are the same as those in Table 20.

Table 28 : Spawning/rearing areas supporting the Snake River Fall-run chinook salmon ESU

State	County	Site	Acres Treated	lbs a.i. Applied
ID	Adams			None
ID	Benewah	Barley	7	4
ID	Benewah	Dry Peas	218	65
ID	Clearwater	Wheat	64	13

ID	Clearwater	Dry Peas	428	128
ID	Clearwater	Alfalfa	24	14
ID	Idaho	Wheat	436	87
ID	Idaho	Barley	26	16
ID	Idaho	Dry Peas	895	269
ID	Idaho	Alfalfa	182	109
ID	Idaho	Hay	6	2
ID	Latah	Wheat	635	127
ID	Latah	Barley	19	11
ID	Latah	Dry Beans	15134	4540
ID	Idaho	Alfalfa	65	39
ID	Idaho	Hay	6	2
ID	Lewis	Wheat	451	90
ID	Lewis	Barley	2	1
ID	Lewis	Dry Peas	4976	1493
ID	Lewis	Alfalfa	35	21
ID	Nez Perce	Wheat	630	126
ID	Nez Perce	Barley	21	13
ID	Nez Perce	Dry Peas	264	79
ID	Nez Perce	Alfalfa	56	34
ID	Shoshone	Alfalfa	2	1
OR	Union	Wheat	1426	285
OR	Union	Potato	436	218
OR	Union	Alfalfa	205	123
OR	Union	Hay	2	1
OR	Wallowa	Wheat	255	51
OR	Willowa	Barley	9	1

OR	Willowa	Alfalfa	164	98
OR	Willowa	Hay	3	1
WA	Adams	Corn	16	3
WA	Adams	Wheat	2127	425
WA	Adams	Potato	18423	9212
WA	Adams	Barley	10	1
WA	Adams	Alfalfa	210	102
WA	Adams	Dry Peas	1198	359
WA	Adams	Asparagus	236	260
WA	Adams	Hay	11	4
WA	Asotin	Wheat	148	30
WA	Asotin	Barley	10	1
WA	Asotin	Alfalfa	15	8
WA	Asotin	Hay	8	3
WA	Franklin	Wheat	767	153
WA	Franklin	Corn	34	7
WA	Franklin	Potato	23609	11804
WA	Franklin	Dry Peas	1198	90
WA	Franklin	Green Peas	80	16
WA	Franklin	Alfalfa	639	320
WA	Franklin	Hay	4	2
WA	Franklin	Asparagus	4822	5304
WA	Franklin	Carrot	357	71
WA	Franklin	Tomato	1	1
WA	Garfield	Wheat	502	100
WA	Garfield	Barley	30	3
WA	Garfield	Alfalfa	7	4

WA	Garfield	Hay	2	1
WA	Walla Walla	Potato	5439	2720
WA	Walla Walla	Dry Peas	3558	1007
WA	Walla Walla	Alfalfa	106	33
WA	Walla Walla	Barley	23	2
WA	Walla Walla	Hay	13	5
WA	Walla Walla	Asparagus	791	870

With the exception of Franklin county Washington, metribuzin use is quite modest within the Snake River, Fall-run Chinook salmon ESU. The low toxicity and short environmental duration imply that registered uses will have no effect on the species of concern.

3. Snake River Spring/Summer-run Chinook Salmon

The Snake River Spring/Summer-run chinook salmon ESU was proposed as threatened in 1991 (56FR29542-29547, June 27, 1991) and listed about a year later (57FR14653-14663, April 22, 1992). Critical habitat was designated on December 28, 1993 (58FR68543-68554) to include all tributaries of the Snake and Salmon Rivers (except the Clearwater River) accessible to Snake River spring/summer chinook salmon. Like the fall-run chinook, the spring/summer-run chinook ESU was proposed for reclassification on December 28, 1994 (59FR66784-57403) as endangered because of critically low levels, based on very sparse runs. However, because of increased runs in subsequent year, this proposed reclassification was withdrawn (63FR1807-1811, January 12, 1998).

Hydrologic units in the potential spawning and rearing areas include Hells Canyon, Imnaha, Lemhi, Little Salmon, Lower Grande Ronde, Lower Middle Fork Salmon, Lower Salmon, Lower Snake-Asotin, Lower Snake-Tucannon, Middle Salmon-Chamberlain, Middle Salmon - Panther, Pahsimerol, South Fork Salmon, Upper Middle Fork Salmon, Upper Grande Ronde, Upper Salmon, and Wallowa. Areas above Hells Canyon Dam are excluded, along with unnamed "impassable natural falls". Napias Creek Falls, near Salmon, Idaho, was later named an upstream barrier (64FR57399-57403, October 25, 1999). The Grande Ronde, Imnaha, Salmon, and Tucannon subbasins, and Asotin, Granite, and Sheep Creeks were specifically named in the Critical Habitat Notice.

Spawning and rearing counties mentioned in the Critical Habitat Notice include Union, Umatilla, Wallowa, and Baker counties in Oregon; Adams, Blaine, Custer, Idaho, Lemhi, Lewis, Nez Perce, and Valley counties in Idaho; and Asotin, Columbia, Franklin, Garfield, Walla Walla, and Whitman counties in Washington. However, Umatilla and Baker counties in Oregon and Blaine County in Idaho are excluded because accessible river reaches are all well above areas where metribuzin can be used. Counties with migratory corridors are all of those down stream from the confluence of the Snake and Columbia Rivers.

Table 29 shows the counties where the Snake River spring/summer-run chinook salmon ESU occurs. The cropping information for the migratory corridors is the same as for the Snake River fall-run chinook salmon and is in the Table 20.

Table 29: Spawning/rearing area supporting the Snake River spring/summer chinook ESU

State	County	Site	Acres Treated	lbs a.i. Applied
ID	Adams			None
ID	Idaho	Wheat	436	87
ID	Idaho	Barley	26	16
ID	Idaho	Dry Peas	895	269
ID	Idaho	Alfalfa	182	109
ID	Idaho	Hay	6	2
ID	Latah	Wheat	635	127
ID	Latah	Barley	19	11
ID	Latah	Dry Beans	15134	4540
ID	Idaho	Alfalfa	65	39
ID	Idaho	Hay	6	2
ID	Lewis	Wheat	451	90
ID	Lewis	Barley	2	1
ID	Lewis	Dry Peas	4976	1493
ID	Lewis	Alfalfa	35	21
ID	Nez Perce	Wheat	630	126
ID	Nez Perce	Barley	21	13
ID	Nez Perce	Dry Peas	264	79
ID	Nez Perce	Alfalfa	56	34
ID	Shoshone	Alfalfa	2	1
ID	Valley	Wheat	5	1
ID	Valley	Potato	12479	7487

ID	Valley	Alfalfa	14	8
OR	Union	Wheat	1426	285
OR	Union	Potato	436	218
OR	Union	Alfalfa	205	123
OR	Union	Hay	2	1
OR	Wallowa	Wheat	255	51
OR	Willowa	Barley	9	1
OR	Willowa	Alfalfa	164	98
OR	Willowa	Hay	3	1
WA	Asotin	Wheat	148	30
WA	Asotin	Barley	10	1
WA	Asotin	Alfalfa	15	8
WA	Asotin	Hay	8	3
WA	Franklin	Wheat	767	153
WA	Franklin	Corn	34	7
WA	Franklin	Potato	23609	11804
WA	Franklin	Dry Peas	1198	90
WA	Franklin	Green Peas	80	16
WA	Franklin	Alfalfa	639	320
WA	Franklin	Hay	4	2
WA	Franklin	Asparagus	4822	5304
WA	Franklin	Carrot	357	71
WA	Franklin	Tomato	1	1
WA	Garfield	Wheat	502	100
WA	Garfield	Barley	30	3
WA	Garfield	Alfalfa	7	4
WA	Garfield	Hay	2	1

WA	Walla Walla	Potato	5439	2720
WA	Walla Walla	Dry Peas	3558	1007
WA	Walla Walla	Alfalfa	106	33
WA	Walla Walla	Barley	23	2
WA	Walla Walla	Hay	13	5
WA	Walla Walla	Asparagus	791	870

With the exception of Franklin county Washington, metribuzin use is quite modest within the Snake River, Spring/Summer-run Chinook salmon ESU. The low toxicity and short environmental duration imply that registered uses will have no effect on the species of concern.

4. Central Valley Spring-run Chinook Salmon ESU

The Central valley Spring-run chinook salmon ESU was proposed as threatened in 1998 (63FR11482-11520, March 9, 1998) and listed on September 16, 1999 (64FR50393-50415). Critical habitat was designated February 16, 2000 (65FR7764-7787) to encompass all river reaches accessible to listed chinook salmon in the Sacramento River and its tributaries in California, along with the down stream river reaches into San Francisco Bay, north of the Oakland Bay Bridge, and to the Golden Gate Bridge

Hydrologic units and upstream barriers within this ESU are the Sacramento-Lower Cow-Lower Clear, Lower Cottonwood, Sacramento-Lower Thomas (upstream barrier - Black Butte Dam), Sacramento-Stone Corral, Lower Butte (upstream barrier - Chesterville Dam), Lower Feather (upstream barrier - Orville Dam), Lower Yuba, Lower Bear (upstream barrier - Camp Far West Dam), Lower Sacramento, Sacramento-Upper Clear (upstream barriers - Keswick Dam, Whiskey town dam), Upper Elder-Upper Thomas, Upper Cow-Battle, Mill-Big Chico, Upper Butte, Upper Yuba (upstream barrier - Englebright Dam), Suisin Bay, San Pablo Bay, and San Francisco Bay. These areas are said to be in the counties of Shasta, Tehama, Butte, Glenn, Colusa, Sutter, Yolo, Yuba, Placer, Sacramento, Solano, Nevada, Contra Costa, Napa, Alameda, Marin, Sonoma, San Mateo, and San Francisco. I note, however, with San Mateo County being well south of the Oakland Bay Bridge, it is difficult to see why this county was included.

Table 30: California counties supporting the Central Valley spring-run chinook salmon ESU.

County	Site	Acres Treated	Lbs a.i. Applied
Alameda			None
Butte			None
Calaveras			None

Colusa	Soil Fumigation	225	111
Colusa	Tomato for Process	1991	843
Contra Costa	Asparagus	1008	141
Contra Costa	Soil Fumigation	38	1
Contra Costa	Uncultivated Ag	593	222
Glenn			None
Merced	Alfalfa	40	30
Merced	Corn, Sweet	105	52
Merced	Tomato	1139	572
Merced	Tomato for Process	211	89
Merced	Wheat	78	39
Marin			None
Placer	Landscape	NS	2
Sacramento	Bean, Unspecified	149	37
Sacramento	Corn for Forage	40	6
Sacramento	Corn, Sweet	1047	74
Sacramento	Landscape	NS	3
Sacramento	Potato	37	14
Sacramento	Tomato	52	7
Sacramento	Tomato for Process	2721	570
San Francisco	Structural Pest Cont	NS	0.05
San Mateo			None
Shasta	Alfalfa	770	552
Solano	Landscape	NS	1
Solano	Research	NS	2
Solano	Tomato	2019	358
Sonoma			None

Sutter	Alfalfa	44	30
Sutter	Corn for Forage	148	111
Sutter	Tomato for Process	2754	992
Tehama			None
Yolo	Alfalfa	146	110
Yolo	Corn for Forage	822	110
Yolo	Research	NS	2
Yolo	Tomato	83	47
Yolo	Tomato for Process	11294	3824
Yolo	Uncultivated Ag	177	88

Use of metribuzin within the California Central Valley, spring-run chinook salmon ESU is relatively low. Combined with the essentially non-toxic character of this chemical, it will have no effect on endangered chinook salmon.

5. California Coastal Chinook Salmon ESU

The California coastal chinook salmon ESU was proposed as threatened in 1998 (63FR11482-11520, March 9, 1998) and listed on September 16, 1999 (64FR50393-50415). Critical habitat was designated February 16, 2000 (65FR7764-7787) to encompass all river reaches and estuarine areas accessible to listed chinook salmon from Redwood Creek (Humboldt County, California) to the Russian River (Sonoma County, California), inclusive.

The Hydrologic units and upstream barriers are Mad-Redwood, Upper Eel (upstream barrier - Scott Dam), Middle Fort Eel, Lower Eel, South Fork Eel, Mattole, Big-Navarro-Garcia, Gualala-Salmon, Russian (upstream barriers - Coyote Dam; Warm Springs Dam), and Bodega Bay. Counties with agricultural areas where metribuzin could be used are Humboldt, Trinity, Mendocino, Lake, Sonoma, Glenn, and Marin.

Table 31: California counties supporting the California coastal chinook salmon ESU.

County	Site	Acres Treated	Lbs a.i. Applied
Glenn			None
Humboldt			None
Lake			None
Marin			None

Mendocino			None
Sonoma			None
Trinity			None

Metribuzin is not applied in the California Coastal chinook salmon ESU. It will have no effect on the species of concern.

6. Puget Sound Chinook Salmon ESU

The Puget Sound chinook salmon ESU was proposed as threatened in 1998 (63FR11482-11520, March 9, 1998) and listed a year later (64FR14308-14328, March 24, 1999). Critical habitat was designated February 16, 2000 (65FR7764-7787) to encompass all marine, estuarine, and river reaches accessible to listed chinook salmon in Puget Sound and its tributaries, extending out to the Pacific Ocean.

The Hydrologic units and upstream barriers are the Strait of Georgia, San Juan Islands, Nooksack, Upper Skagit, Sauk, Lower Skagit, Stillaguamish, Skykomish, Snoqualmie (upstream barrier - Tolt Dam), Snohomish, Lake Washington (upstream barrier - Landsburg Diversion), Duwamish, Puyallup, Nisqually (upstream barrier - Alder Dam), Deschutes, Skokomish, Hood Canal, Puget Sound, Dungeness-Elwha (upstream barrier - Elwha Dam). Affected counties in Washington, apparently all of which could have spawning and rearing habitat, are Skagit, Whatcom, San Juan, Island, Snohomish, King, Pierce, Thurston, Lewis, Grays Harbor, Mason, Clallam, Jefferson, and Kitsap.

Table 32: Washington counties where the Puget Sound chinook salmon ESU is located.

State	County	Site	Acres Treated	lbs a.i. Applied
WA	Clallum	Alfalfa	8	4
WA	Clallum	Hay	3	1
WA	Grays Harbor			None
WA	Jefferson	Hay	3	1
WA	King	Potato	1	1
WA	King	Alfalfa	1	1
WA	King	Tomato	1	1
WA	Kitsap	Potato	1	1
WA	Lewis	Wheat	8	2

WA	Lewis	Alfalfa	8	4
WA	Lewis	Hay	5	2
WA	Lewis	Green Peas	229	46
WA	Mason	Alfalfa	1	1
WA	Pierce	Potato	5	3
WA	Pierce	Alfalfa	1	1
WA	Pierce	Hay	16	6
WA	San Juan	Potato	1	1
WA	San Juan	Hay	12	4
WA	Skagit	Wheat	24	5
WA	Skagit	Alfalfa	7	4
WA	Skagit	Hay`	23	9
WA	Skagit	Carrot	56	11
WA	Skagit	Green Peas	1526	305
WA	Skagit	Potato	4586	2293
WA	Snohomish	Wheat	3	2
WA	Snohomish	Alfalfa	2	1
WA	Snohomish	Hay	17	6
WA	Snohomish	Green Peas	471	94
WA	Thurston	Alfalfa	4	2
WA	Thurston	Hay	20	8
WA	Whatcom	Wheat	353	71
WA	Whatcom	Potato	1046	523
WA	Whatcom	Alfalfa	6	3
WA	Whatcom	Hay	45	23
WA	Whatcom	Tomato	2	1
WA	Whatcom	Green Peas	770	154

Use of metribuzin within the Puget Sound Chinook salmon ESU, an area of mainly urban development, is very modest. It's use will have no effect on the listed species of concern.

7. Lower Columbia River Chinook Salmon ESU

The Lower Columbia River chinook salmon ESU was proposed as threatened in 1998 (63FR11482-11520, March 9, 1998) and listed a year later (64FR14308-14328, March 24, 1999). Critical habitat was designated February 16, 2000 (65FR7764-7787) to encompass all river reaches accessible to listed chinook salmon in Columbia River tributaries between the Grays and White Salmon Rivers in Washington and the Willamette and Hood Rivers in Oregon, inclusive, along with the lower Columbia River reaches to the Pacific Ocean.

The Hydrologic units and upstream barriers are the Middle Columbia-Hood (upstream barriers - Condit Dam, The Dalles Dam), Lower Columbia-Sandy (upstream barrier - Bull Run Dam 2), Lewis (upstream barrier - Merlin Dam), Lower Columbia-Clatskanie, Upper Cowlitz, Lower Cowlitz, Lower Columbia, Clackamas, and the Lower Willamette. Spawning and rearing habitat would be in the counties of Hood River, Waco, Columbia, Clackamas, Marion, Multnomah, and Washington in Oregon, and Klickitat, Skamania, Clark, Cowlitz, Lewis, Wahkiakum, Pacific, Yakima, and Pierce in Washington. Clatsop County appears to be the only county in the critical habitat that does not contain spawning and rearing habitat, although there is only a small part of Marion County that is included as critical habitat. Pierce County, Washington was excluded because the very small part of the Cowlitz River watershed in this county is at a high elevation where metribuzin would not be used.

Table 33: Oregon and Washington counties where the Lower Columbia River chinook salmon ESU occurs.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Clackamus	Alfalfa	10	6
OR	Clackamus	Hay	5	2
OR	Clackamus	Green Peas	10	2
OR	Clackamus	Tomato	6	3
OR	Clackamus	Corn	5	1
OR	Clatsop			None
OR	Hood River	Alfalfa	4	2
OR	Marion	Wheat	72	14
OR	Marion	Alfalfa	12	7
OR	Marion	Hay	4	2

OR	Marion	Carrot	8	2
OR	Marion	Corn	67	13
OR	Marion	Tomato	53	
OR	Marion	Green Peas	69	14
OR	Multnomah	Wheat	12	2
OR	Multnomah	Potato	222	111
OR	Multnomah	Alfalfa	4	2
OR	Multnomah	Green Peas	62	12
OR	Multnomah	Corn	6	1
OR	Multnomah	Tomato	6	3
OR	Wasco	Wheat	102	20
OR	Wasco	Alfalfa	65	39
OR	Washington	Wheat	119	24
OR	Washington	Alfalfa	15	6
OR	Washington	Hay	3	1
OR	Washington	Tomato	4	2
WA	Clark	Hay	38	15
WA	Clark	Tomato	3	2
WA	Cowlitz	Hay	73	3
WA	Cowletz	Alfalfa	1	1
WA	Cowletz	Green Peas	108	22
WA	Klikitat	Wheat	283	57
WA	Klikitat	Barley	8	1
WA	Klikitat	Alfalfa	256	128
WA	Klikitat	Hay	13	5
WA	Klikitat	Tomato	3	2
WA	Lewis	Wheat	8	2

WA	Lewis	Alfalfa	8	4
WA	Lewis	Hay	5	2
WA	Lewis	Green Peas	229	46
WA	Pacific	Alfalfa	1	1
WA	Pacific	Hay	7	3
WA	Skamania	Alfalfa	2	1
WA	Wakiakum			None

Use of metribuzin within the Lower Columbia Chinook salmon ESU is very limited. Registered use will have no effect on the species of concern.

8. Upper Willamette River Chinook Salmon ESU

The Upper Willamette River Chinook Salmon ESU was proposed as threatened in 1998 (63FR11482-11520, March 9, 1998) and listed a year later (64FR14308-14328, March 24, 1999). Critical habitat was designated February 16, 2000 (65FR7764-7787) to encompass all river reaches accessible to listed chinook salmon in the Clackamas River and the Willamette River and its tributaries above Willamette Falls, in addition to all down stream river reaches of the Willamette and Columbia Rivers to the Pacific Ocean.

The Hydrologic units included are the Lower Columbia-Sandy, Lower Columbia-Clatskanie, Lower Columbia, Middle Fork Willamette, Coast Fork Willamette (upstream barriers - Cottage Grove Dam, Dorena Dam), Upper Willamette (upstream barrier - Fern Ridge Dam), McKenzie (upstream barrier - Blue River Dam), North Santiam (upstream barrier - Big Cliff Dam), South Santiam (upstream barrier - Green Peter Dam), Middle Willamette, Yamhill, Molalla-Pudding, Tualatin, Clackamas, and Lower Willamette. Spawning and rearing habitat is in the Oregon counties of Clackamas, Douglas, Lane, Benton, Lincoln, Linn, Polk, Marion, Yamhill, Washington, and Tillamook. However, Lincoln and Tillamook counties include salmon habitat only in the forested parts of the coast range where metribuzin would not be used. Salmon habitat for this ESU is exceedingly limited in Douglas County also, but we cannot rule out future metribuzin use in Douglas County.

Tables 34 and 35 show the cropping information for Oregon counties where the Upper Willamette River chinook salmon ESU occurs and for the Oregon and Washington counties where this ESU migrates.

Table 34: Spawning/Rearing areas for the Upper Willamette River chinook ESU

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Benton	Wheat	20	6

OR	Benton	Potato	5	3
OR	Benton	Alfalfa	5	3
OR	Benton	Hay	2	1
OR	Benton	Corn	19	4
OR	Benton	Tomato	2	1
OR	Clackamus	Alfalfa	10	6
OR	Clackamus	Hay	5	2
OR	Clackamus	Green Peas	10	2
OR	Clackamus	Tomato	6	3
OR	Clackamus	Corn	5	1
OR	Douglas	Alfalfa	18	10
OR	Douglas	Tomato	12	6
OR	Douglas	Hay	11	4
OR	Lane	Alfalfa	8	5
OR	Lane	Hay	22	5
OR	Lane	Corn	12	2
OR	Lane	Potato	6	3
OR	Lane	Tomato	16	8
OR	Linn	Alfalfa	23	13
OR	Linn	Hay	13	5
OR	Linn	Corn	27	5
OR	Linn	Tomato	2	1
OR	Marion	Wheat	72	14
OR	Marion	Alfalfa	12	7
OR	Marion	Hay	4	2
OR	Marion	Carrot	8	2
OR	Marion	Corn	67	13

OR	Marion	Tomato	53	
OR	Marion	Green Peas	69	14
OR	Polk	Wheat	66	13
OR	Washington	Alfalfa	15	6
OR	Washington	Hay	3	1
OR	Washington	Tomato	4	2
OR	Polk	Alfalfa	7	4
OR	Polk	Hay	5	2
OR	Polk	Corn	13	3
OR	Polk	Tomato	2	1
OR	Yamill	Barley	38	23
OR	Yamill	Alfalfa	21	13
OR	Yamill	Hay	4	2
OR	Yamill	Corn	25	5
OR	Yamill	Tomato	2	1
OR	Yamhill	Wheat	98	20

Table 35: Migration corridors of the Upper Willamette River chinook salmon ESU.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Clatsop			
OR	Columbia	Wheat	13	3
OR	Columbia	Alfalfa	2	2
OR	Columbia	Hay	2	1
OR	Multnomah	Wheat	12	2
OR	Multnomah	Potato	222	111
OR	Multnomah	Alfalfa	4	2
OR	Multnomah	Green Peas	62	12
OR	Multnomah	Corn	6	1

OR	Multnomah	Tomato	6	3
WA	Clark	Hay	38	15
WA	Clark	Tomato	3	2
WA	Cowlitz	Hay	73	3
WA	Cowletz	Alfalfa	1	1
WA	Cowletz	Green Peas	108	22
WA	Pacific	Alfalfa	1	1
WA	Pacific	Hay	7	3
WA	Wahkiakum			None

Use of metribuzin within the Upper Willamette River Chinook salmon ESU is very limited. Registered use will have no effect on the species of concern

9. Upper Columbia River Spring-run Chinook Salmon ESU

The Upper Columbia River Spring-run Chinook Salmon ESU was proposed as endangered in 1998 (63FR11482-11520, March 9, 1998) and listed a year later (64FR14308-14328, March 24, 1999). Critical habitat was designated February 16, 2000 (65FR7764-7787) to encompass all river reaches accessible to listed chinook salmon in Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River, as well as all down stream migratory corridors to the Pacific Ocean. Hydrologic units and their upstream barriers are Chief Joseph (Chief Joseph Dam), Similkameen, Methow, Upper Columbia-Entiat, Wenatchee, Upper Columbia-Priest Rapids, Middle Columbia-Lake Wallula, Middle Columbia-Hood, Lower Columbia-Sandy, Lower Columbia-Clatskanie, Lower Columbia, and Lower Willamette. Counties in which spawning and rearing occur are Chelan, Douglas, Okanogan, Grant, Kittitas, and Benton (Table 36), with the lower river reaches being migratory corridors (Table 37).

Most metribuzin usage occurs upstream from the confluence of the Snake River with the Columbia River, but not as far north as Chelan, and Okanogan counties, where there is limited acreage of potato, the only crop for metribuzin. However, a modest amount is used on potato below that confluence in counties on either side of the Columbia River, but all upstream of the John Day Dam.

Tables 36 and 37 show the cropping information for Washington counties that support the Upper Columbia River chinook salmon ESU and for the Oregon and Washington counties where this ESU migrates.

Table 36. Counties Supporting the Upper Columbia Chinook ESU Spawning/Rearing Area

State	County	Site	Acres Treated	lbs a.i. Applied
WA	Benton	Wheat	917	183
WA	Benton	Potato	18423	9212
WA	Benton	Asparagus	236	260
WA	Benton	Alfalfa	119	60
WA	Benton	Tomato	1	1
WA	Chelan	Wheat	13	3
WA	Chelan	Alfalfa	8	4
WA	Chelan	Hay	2	1
WA	Douglas	Wheat	1402	280
WA	Douglas	Barley	3	1
WA	Douglas	Alfalfa	16	8
WA	Grant	Wheat	1425	285
WA	Grant	Corn	90	18
WA	Grant	Barley	9	1
WA	Grant	Potato	29214	14607
WA	Grant	Dry Peas	2936	801
WA	Grant	Green Peas	80	16
WA	Grant	Alfalfa	7	4
WA	Grant	Hay	12	5
WA	Grant	Asparagus	526	579
WA	Grant	Carrot	201	42
WA	Grant	Tomato	2	1
WA	Kittitas	Wheat	27	7
WA	Kittitas	Potato	292	145
WA	Kittitas	Alfalfa	77	39

WA	Kittitas	Hay	13	5
WA	Okanogan	Alfalfa	197	99
WA	Okanogan	Hay	7	3
WA	Skamania	Alfalfa	2	1

Table 37: Migration corridors for the Upper Columbia River Chinook salmon ESU.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Clatsop			None
OR	Columbia	Wheat	13	3
OR	Columbia	Alfalfa	2	2
OR	Columbia	Hay	2	1
OR	Gilliam	Wheat	669	134
OR	Gilliam	Barley	13	8
OR	Gilliam	Alfalfa	22	13
OR	Hood River	Alfalfa	4	2
OR	Morrow	Wheat	1170	234
OR	Morrow	Barley	3	2
OR	Morrow	Potato	11240	5620
OR	Morrow	Alfalfa	200	120
OR	Morrow	Green Peas	73	15
OR	Morrow	Corn	14	3
OR	Multnomah	Wheat	12	2
OR	Multnomah	Potato	222	111
OR	Multnomah	Alfalfa	4	2
OR	Multnomah	Green Peas	62	12
OR	Multnomah	Corn	6	1
OR	Multnomah	Tomato	6	3
OR	Sherman			

OR	Umatilla	Wheat	1843	360
OR	Umatilla	Barley	16	10
OR	Umatilla	Dry Peas	1779	321
OR	Umatilla	Green Peas	2817	563
OR	Umatilla	Potato	9902	4951
OR	Umatilla	Alfalfa	216	120
OR	Umatilla	Hay	3	1
OR	Umatilla	Corn	12	2
OR	Umatilla	Tomato	8	4
OR	Wasco	Alfalfa	65	39
WA	Cowlitz	Alfalfa	1	1
WA	Cowletz	Hay	7	3
WA	Cowletz	Green Peas	108	22
WA	Franklin	Wheat	767	153
WA	Franklin	Corn	34	7
WA	Franklin	Potato	23609	11804
WA	Franklin	Dry Peas	1198	90
WA	Franklin	Green Peas	80	16
WA	Franklin	Alfalfa	639	320
WA	Franklin	Hay	4	2
WA	Franklin	Asparagus	4822	5304
WA	Franklin	Carrot	357	71
WA	Franklin	Tomato	1	1
WA	Klikitat	Wheat	283	57
WA	Klikitat	Barley	8	1
WA	Klikitat	Alfalfa	256	128
WA	Klikitat	Hay	13	5

WA	Klikitat	Tomato	3	2
WA	Skamania	Alfalfa	2	1
WA	Pacific	Alfalfa	1	1
WA	Pacific	Hay	7	3
WA	Walla Walla	Potato	5439	2720
WA	Walla Walla	Dry Peas	3558	1007
WA	Walla Walla	Alfalfa	106	33
WA	Walla Walla	Barley	23	2
WA	Walla Walla	Hay	13	5
WA	Walla Walla	Asparagus	791	870
WA	Yakima	Wheat	353	71
WA	Yakima	Corn	38	8
WA	Yakima	Potato	1273	637
WA	Yakima	Alfalfa	205	153
WA	Yakima	Hay	5	2
WA	Yakima	Asparagus	3939	4333
WA	Yakima	Tomato	85	30
WA	Yakima	Green Peas	10	14

Significant use of metribuzin within the Upper Columbia Chinook salmon ESU is limited to Benton, Grant, Franklin, Walla Walla, and Yakima counties in Washington and Umatilla county in Oregon. The short half-life and low toxicity of the chemical, however, indicate it will have no effect on the listed species of concern.

C. Coho Salmon

Coho salmon, *Oncorhynchus kisutch*, were historically distributed throughout the North Pacific Ocean from central California to Point Hope, AK, through the Aleutian Islands into Asia. Historically, this species probably inhabited most coastal streams in Washington, Oregon, and central and northern California. Some populations may once have migrated hundreds of miles inland to spawn in tributaries of the upper Columbia River in Washington and the Snake River in Idaho.

Coho salmon generally exhibit a relatively simple, 3 year life cycle. Adults typically begin their freshwater spawning migration in the late summer and fall, spawn by mid-winter, then die. Southern populations are somewhat later and spend much less time in the river prior to spawning than do northern coho. Homing fidelity in coho salmon is generally strong; however their small tributary habitats experience relatively frequent, temporary blockages, and there are a number of examples in which coho salmon have rapidly re-colonized vacant habitat that had only recently become accessible to anadromous fish.

After spawning in late fall and early winter, eggs incubate in redds for 1.5 to 4 months, depending upon the temperature, before hatching as alevins. Following yolk sac absorption, alevins emerge and begin actively feeding as fry. Juveniles rear in fresh water for up to 15 months, then migrate to the ocean as ‘‘smolts’’ in the spring. Coho salmon typically spend two growing seasons in the ocean before returning to their natal stream. They are most frequently recovered from ocean waters in the vicinity of their spawning streams, with a minority being recovered at adjacent coastal areas, decreasing in number with distance from the natal streams. However, those coho released from Puget Sound, Hood Canal, and the Strait of Juan de Fuca are caught at high levels in Puget Sound, an area not entered by coho salmon from other areas.

1. Central California Coast Coho Salmon ESU

The Central California Coast Coho Salmon ESU includes all coho naturally reproduced in streams between Punta Gorda, Humboldt County, CA and San Lorenzo River, Santa Cruz County, CA, inclusive. This ESU was proposed in 1995 (60FR38011-38030, July 25, 1995) and listed as threatened, with critical habitat designated, on May 5, 1999 (64FR24049-24062). Critical habitat consists of accessible reaches along the coast, including Arroyo Corte Madera Del Presidio and Corte Madera Creek, tributaries to San Francisco Bay.

Hydrologic units within the boundaries of this ESU are: San Lorenzo-Soquel (upstream barrier - Newell Dam), San Francisco Coastal South, San Pablo Bay (upstream barrier - Phoenix Dam- Phoenix Lake), Tomales-Drake Bays (upstream barriers - Peters Dam-Kent Lake; Seeger Dam-Nicasio Reservoir), Bodega Bay, Russian (upstream barriers - Warm springs dam-Lake Sonoma; Coyote Dam-Lake Mendocino), Gualala-Salmon, and Big-Navarro-Garcia. California counties included are Santa Cruz, San Mateo, Marin, Napa, Sonoma, and Mendocino.

Table 38: California counties supporting the Central California coast Coho salmon ESU.

County	Site	Acres Treated	Lbs a.i. Applied
Marin			None
Mendocino			None
Napa			None
San Mateo			None

Santa Cruz			None
Sonoma			None

Metribuzin is not applied within the Central California Coast Coho salmon ESU. It will have no effect on the endangered coho salmon.

2. Southern Oregon/Northern California Coast Coho Salmon ESU

The Southern Oregon/Northern California coastal coho salmon ESU was proposed as threatened in 1995 (60FR38011-38030, July 25, 1995) and listed on May 6, 1997 (62FR24588-24609). Critical habitat was proposed later that year (62FR62741-62751, November 25, 1997) and finally designated on May 5, 1999 (64FR24049-24062) to encompass accessible reaches of all rivers (including estuarine areas and tributaries) between the Mattole River in California and the Elk River in Oregon, inclusive.

The Southern Oregon/Northern California Coast coho salmon ESU occurs between Punta Gorda, Humboldt County, California and Cape Blanco, Curry County, Oregon. Major basins with this salmon ESU are the Rogue, Klamath, Trinity, and Eel river basins, while the Elk River, Oregon, and the Smith and Mad Rivers, and Redwood Creek, California are smaller basins within the range. Hydrologic units and the upstream barriers are Mattole, South Fork Eel, Lower Eel, Middle Fork Eel, Upper Eel (upstream barrier - Scott Dam-Lake Pillsbury), Mad-Redwood, Smith, South Fork Trinity, Trinity (upstream barrier - Lewiston Dam-Lewiston Reservoir), Salmon, Lower Klamath, Scott, Shasta (upstream barrier - Dwinnell Dam-Dwinnell Reservoir), Upper Klamath (upstream barrier - Irongate Dam-Irongate Reservoir), Chetco, Illinois (upstream barrier - Selmac Dam-Lake Selmac), Lower Rogue, Applegate (upstream barrier - Applegate Dam-Applegate Reservoir), Middle Rogue (upstream barrier - Emigrant Lake Dam-Emigrant Lake), Upper Rogue (upstream barriers - Agate Lake Dam-Agate Lake; Fish Lake Dam-Fish Lake; Willow Lake Dam-Willow Lake; Lost Creek Dam-Lost Creek Reservoir), and Sixes. Related counties are Humboldt, Mendocino, Trinity, Glenn, Lake, Del Norte, Siskiyou in California and Curry, Jackson, Josephine, and Douglas, in Oregon. However, I have excluded Glenn County, California from this analysis because the salmon habitat in this county is not near the agricultural areas where metribuzin can be used. Klamath county is excluded because it lies beyond an impassable barrier.

Tables 39 shows the usage of metribuzin in the California counties supporting the Southern Oregon/Northern California coastal coho salmon ESU. Table 40 shows the cropping information for Oregon counties where the Southern Oregon/Northern California coastal coho salmon ESU occurs..

Table 39.:California Counties where the Southern Oregon/Northern California Coastal Coho Salmon ESU Occurs

County	Site	Acres Treated	Lbs a.i. Applied

Del Norte			None
Humboldt			None
Lake			None
Mendocino			None
Trinity			None

[1] **Not a currently registered use.**

Table 40. Oregon counties where there is habitat for the Southern Oregon/Northern California coastal coho salmon ESU.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Curry			None
WA	Douglas	Wheat	1402	280
WA	Douglas	Barley	3	1
WA	Douglas	Alfalfa	16	8
OR	Jackson	Barley	1	1
OR	Jackson	Alfalfa	36	22
OR	Jackson	Tomato	3	2
OR	Josephine	Potato	642	321
OR	Josephine	Alfalfa	10	6
OR	Josephine	Hay	2	1
OR	Josephine	Tomato	2	1

There is minimal use of metribuzon within the southern Oregon/Northern California coastal Coho salmon ESU. It will have no effects on the species of concern.
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3. Oregon Coast coho salmon ESU

The Oregon coast coho salmon ESU was first proposed for listing as threatened in 1995 (60FR38011-38030, July 25, 1995), and listed several years later 63FR42587-42591, August 10, 1998). Critical habitat was proposed in 1999 (64FR24998-25007, May 10, 1999) and designated on February 16, 2000 (65FR7764-7787).

This ESU includes coastal populations of coho salmon from Cape Blanco, Curry County, Oregon to the Columbia River. Spawning is spread over many basins, large and small, with higher numbers further south where the coastal lake systems (e.g., the Tenmile, Tahkenitch, and Siltcoos basins) and the Coos and Coquille Rivers have been particularly productive. Critical Habitat includes all accessible reaches in the coastal Hydrologic reaches Necanicum, Nehalem, Wilson-Trask-Nestucca (upstream barrier - McGuire Dam), Siletz-Yaquina, Alsea, Siuslaw, Siltcoos, North Umpqua (upstream barriers - Cooper Creek Dam, Soda Springs Dam), South Umpqua (upstream barrier - Ben Irving Dam, Galesville Dam, Win Walker Reservoir), Umpqua, Coos (upstream barrier - Lower Pony Creek Dam), Coquille, Sixes. Related Oregon counties are Douglas, Lane, Coos, Curry, Benton, Lincoln, Polk, Tillamook, Yamhill, Washington, Columbia, Clatsop. However, the portions of Yamhill, Washington, and Columbia counties that are within the ESU do not include agricultural areas where methamidophos can be used, and they were eliminated in this analysis.

Table 41: Oregon counties where the Oregon coast coho salmon ESU occurs.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Benton	Wheat	20	6
OR	Benton	Potato	5	3
OR	Benton	Alfalfa	5	3
OR	Benton	Hay	2	1
OR	Benton	Corn	19	4
OR	Benton	Tomato	2	1
OR	Clatsop			None
OR	Coos	Hay	3	1
OR	Curry			None
OR	Douglas			
OR	Lane	Alfalfa	8	5
OR	Lane	Hay	22	5
OR	Lane	Corn	12	2
OR	Lane	Potato	6	3
OR	Lane	Tomato	16	8
OR	Lincoln			None
OR	Polk	Wheat	66	13

OR	Polk	Alfalfa	7	4
OR	Polk	Hay	5	2
OR	Polk	Corn	13	3
OR	Polk	Tomato	2	1
OR	Tillamook			None

There is very minimal application of metribuzin within the Oregon Coast Coho salmon ESU. It will have no effect on the species of concern.

D. Chum Salmon

Chum salmon, *Oncorhynchus keta*, have the widest natural geographic and spawning distribution of any Pacific salmonid, primarily because its range extends farther along the shores of the Arctic Ocean. Chum salmon have been documented to spawn from Asia around the rim of the North Pacific Ocean to Monterey Bay in central California. Presently, major spawning populations are found only as far south as Tillamook Bay on the northern Oregon coast.

Most chum salmon mature between 3 and 5 years of age, usually 4 years, with younger fish being more predominant in southern parts of their range. Chum salmon usually spawn in coastal areas, typically within 100 km of the ocean where they do not have surmount river blockages and falls. However, in the Skagit River, Washington, they migrate at least 170 km.

During the spawning migration, adult chum salmon enter natal river systems from June to March, depending on characteristics of the population or geographic location. . In Washington, a variety of seasonal runs are recognized, including summer, fall, and winter populations. Fall-run fish predominate, but summer runs are found in Hood Canal, the Strait of Juan de Fuca, and in southern Puget Sound, and two rivers in southern Puget Sound have winter-run fish.

Redds are usually dug in the mainstem or in side channels of rivers. Juveniles outmigrate to seawater almost immediately after emerging from the gravel that covers their redds. This means that survival and growth in juvenile chum salmon depend less on freshwater conditions than on favorable estuarine and marine conditions.

<u>1. Hood Canal Summer-run chum salmon ESU</u>

The Hood Canal summer-run chum salmon ESU was proposed for listing as threatened, and critical habitat was proposed, in 1998 (63FR11774-11795, March 10, 1998). The final listing was published a year later (63FR14508-14517, March 25, 1999), and critical habitat was designated in 2000 (65FR7764-7787).

Critical habitat for the Hood Canal ESU includes Hood Canal, Admiralty Inlet, and the straits of Juan de Fuca, along with all river reaches accessible to listed chum salmon draining into Hood Canal as well as Olympic Peninsula rivers between Hood Canal and Dungeness Bay, Washington. The Hydrologic units are Skokomish (upstream boundary - Cushman Dam), Hood Canal, Puget Sound, Dungeness-Elwha, in the counties of Mason, Clallam, Jefferson, Kitsap, and Island.

Streams specifically mentioned, in addition to Hood Canal, in the proposed critical habitat Notice include Union River, Tahuya River, Big Quilcene River, Big Beef Creek, Anderson Creek, Dewatto River, Snow Creek, Salmon Creek, Jimmycomelately Creek, Duckabush 'stream', Hamma Hamma 'stream', and Dosewallips 'stream'.

Tables 42: Washington counties where the Hood Canal summer-run chum salmon ESU Occurs.

State	County	Site	Acres Treated	lbs a.i. Applied
WA	Clallum	Alfalfa	8	4
WA	Clallum	Hay	7	1
WA	Island	Alfalfa	19	10
WA	Island	Hay	6	2
WA	Jefferson	Hay	3	1
WA	Kitsap	Potato	1	1
WA	Kitsap	Hay	2	1

There is very minimal application of metribuzin within the Hood Canal, Summer-run Chum salmon ESU. It will have no effect on the species of concern.

2. Columbia River Chum Salmon ESU

The Columbia River chum salmon ESU was proposed for listing as threatened, and critical habitat was proposed, in 1998 (63FR11774-11795, March 10, 1998). The final listing was published a year later (63FR14508-14517, March 25, 1999), and critical habitat was designated in 2000 (65FR7764-7787).

Critical habitat for the Columbia River chum salmon ESU encompasses all accessible reaches and adjacent riparian zones of the Columbia River (including estuarine areas and tributaries) downstream from Bonneville Dam, excluding Oregon tributaries upstream of Milton Creek at river km 144 near the town of St. Helens. These areas are the Hydrologic units of Lower Columbia - Sandy (upstream barrier - Bonneville Dam, Lewis (upstream barrier - Merlin Dam), Lower Columbia - Clatskanie, Lower Cowlitz, Lower Columbia, Lower Willamette in the counties of Clark, Skamania, Cowlitz, Wahkiakum, Pacific, Lewis, Washington and Multnomah, Clatsop, Columbia, and Washington, Oregon. It appears that there are three extant populations in Grays River, Hardy Creek, and Hamilton Creek.

Table 43: Oregon and Washington counties where the Columbia River chum salmon ESU occurs.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Clatsop			None
OR	Columbia	Wheat	13	3
OR	Columbia	Alfalfa	2	2
OR	Columbia	Hay	2	1
OR	Multnomah	Wheat	12	2
OR	Multnomah	Potato	222	111
OR	Multnomah	Alfalfa	4	2
OR	Multnomah	Green Peas	62	12
OR	Multnomah	Corn	6	1
OR	Multnomah	Tomato	6	3
OR	Washington			
WA	Clark	Hay	38	15
WA	Clark	Tomato	3	2
WA	Cowlitz	Hay	73	3
WA	Cowletz	Alfalfa	1	1
WA	Cowletz	Green Peas	108	22
WA	Lewis	Wheat	8	2
WA	Lewis	Alfalfa	8	4
WA	Lewis	Hay	5	2
WA	Lewis	Green Peas	229	46

WA	Pacific	Alfalfa	1	1
WA	Pacific	Hay	7	3
WA	Skamania	Alfalfa	2	1
WA	Wahkiakum			None

There is very minimal application of metribuzin within the Columbia River Chum salmon ESU. It will have no effect on the species of concern.

E. Sockeye Salmon

Sockeye salmon, *Oncorhynchus nerka*, are the third most abundant species of Pacific salmon, after pink and chum salmon. Sockeye salmon exhibit a wide variety of life history patterns that reflect varying dependency on the fresh water environment. The vast majority of sockeye salmon typically spawn in inlet or outlet tributaries of lakes or along the shoreline of lakes, where their distribution and abundance is closely related to the location of rivers that provide access to the lakes. Some sockeye, known as kokanee, are non-anadromous and have been observed on the spawning grounds together with their anadromous counterparts. Some sockeye, particularly the more northern populations, spawn in mainstem rivers.

Growth is influenced by competition, food supply, water temperature, thermal stratification, and other factors, with lake residence time usually increasing the farther north a nursery lake is located. In Washington and British Columbia, lake residence is normally 1 or 2 years. Incubation, fry emergence, spawning, and adult lake entry often involve intricate patterns of adult and juvenile migration and orientation not seen in other *Oncorhynchus* species. Upon emergence from the substrate, lake-type sockeye salmon juveniles move either downstream or upstream to rearing lakes, where the juveniles rear for 1 to 3 years prior to migrating to sea. Smolt migration typically occurs beginning in late April and extending through early July.

Once in the ocean, sockeye salmon feed on copepods, euphausiids, amphipods, crustacean larvae, fish larvae, squid, and pteropods. They will spend from 1 to 4 years in the ocean before returning to freshwater to spawn. Adult sockeye salmon home precisely to their natal stream or lake. River-and sea-type sockeye salmon have higher straying rates within river systems than lake-type sockeye salmon.

<u>1. Ozette Lake Sockeye Salmon ESU</u>

The Ozette Lake sockeye salmon ESU was proposed for listing, along with proposed critical habitat in 1998 (63FR11750-11771, March 10, 1998). It was listed as threatened on March 25, 1999 (64FR14528-14536), and critical habitat was designated on February 16, 2000 (65FR7764-7787). This ESU spawns in Lake Ozette, Clallam County, Washington, as well as in its outlet stream and the tributaries to the lake. It has the smallest distribution of any listed Pacific salmon.

While Lake Ozette, itself, is part of Olympic National Park, its tributaries extend outside park boundaries, much of which is private land. There is limited agriculture in the whole of Clallam County, and most of this is well away from the Ozette watershed.

Table 44: Clallum County where there is habitat for the Ozette Lake sockeye salmon ESU.

State	County	Site	Acres Treated	lbs a.i. Applied
WA	Clallum	Alfalfa	6	4

Metribuzin is used in very minimal quantities in Clallum county, the site of the Ozette Lake salmon ESU. It will have no effect on the species of concern.

<u>2. Snake River Sockeye Salmon ESU</u>

The Snake River sockeye salmon was the first salmon ESU in the Pacific Northwest to be listed. It was proposed and listed in 1991 (56FR14055-14066, April 5, 1991 & 56FR58619-58624, November 20, 1991). Critical habitat was proposed in 1992 (57FR57051-57056, December 2, 1992) and designated a year later (58FR68543-68554, December 28, 1993) to include river reaches of the mainstem Columbia River, Snake River, and Salmon River from its confluence with the outlet of Stanley Lake down stream, along with Alturas Lake Creek, Valley Creek, and Stanley, Redfish, Yellow Belly, Pettit, and Alturas lakes (including their inlet and outlet creeks).

Spawning and rearing habitats are considered to be all of the above-named lakes and creeks, even though at the time of the Critical Habitat Notice, spawning only still occurred in Redfish Lake. These habitats are in Custer and Blaine counties in Idaho. However, the habitat area for the salmon is at high elevation, above the agriculture zone, and in protected areas of a National Wilderness area and National Forest. Methamidophos cannot be used on such a site, and therefore there will be no exposure in the spawning and rearing habitat. There is a probability that this salmon ESU could be exposed to methamidophos in the lower and larger river reaches during its juvenile or adult migration.

Table 45 shows the limited acreage of crops in Idaho counties where this ESU reproduces. All of this crop production is away from and at a much lower elevation than the spawning and rearing habitat. The critical spawning zones demonstrate, at the maximum allowable application levels, the potential for 786 lbs of methamidophos, distributed over 393 A of cultivated land and a much larger area (>25,000 A) not including non-agricultural properties

Table 46 shows the acreage of crops where metribuzin can be used in Oregon and Washington counties along the migratory corridor for this ESU.

Table 45. Idaho counties where there is spawning and rearing habitat for the Snake River sockeye salmon ESU.

State	County	Site	Acres Treated	lbs a.i. Applied
ID	Blaine	Wheat	3	1
ID	Blaine	Potato	560	200
ID	Blaine	Alfalfa	157	94
ID	Blaine	Hay	225	1
ID	Custer	Barley	29	17
ID	Custer	Potato	220	132

Table 46. Oregon and Washington counties that are in the migratory corridors for the Snake River sockeye salmon ESU.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Clatsop			None
OR	Columbia	Wheat	13	3
OR	Columbia	Alfalfa	2	2
OR	Columbia	Hay	2	1
OR	Gilliam	Wheat	669	134
OR	Gilliam	Barley	13	8
OR	Gilliam	Alfalfa	22	13
OR	Hood River	Alfalfa	4	2
OR	Morrow	Wheat	1170	234
OR	Morrow	Barley	3	2
OR	Morrow	Potato	11240	5620
OR	Morrow	Alfalfa	200	120
OR	Morrow	Green Peas	73	15

OR	Morrow	Corn	14	3
OR	Multnomah	Wheat	12	2
OR	Multnomah	Potato	222	111
OR	Multnomah	Alfalfa	4	2
OR	Multnomah	Green Peas	62	12
OR	Multnomah	Corn	6	1
OR	Multnomah	Tomato	6	3
OR	Sherman			
OR	Umatilla	Wheat	1843	360
OR	Umatilla	Barley	16	10
OR	Umatilla	Dry Peas	1779	321
OR	Umatilla	Green Peas	2817	563
OR	Umatilla	Potato	9902	4951
OR	Umatilla	Alfalfa	216	120
OR	Umatilla	Hay	3	1
OR	Umatilla	Corn	12	2
OR	Umatilla	Tomato	8	4
OR	Wallowa			None
OR	Wasco	Alfalfa	65	39
WA	Asotin	Wheat	148	30
WA	Asotin	Barley	10	1
WA	Asotin	Alfalfa	15	8
WA	Asotin	Hay	8	3
WA	Benton	Wheat	917	183
WA	Benton	Potato	18423	9212
WA	Benton	Asparagus	236	260
WA	Benton	Alfalfa	119	60

WA	Benton	Tomato	1	1
WA	Clark	Hay	38	15
WA	Clark	Tomato	3	2
WA	Columbia	Barley	18	2
WA	Columbia	Dry Peas	3777	1133
WA	Columbia	Alfalfa	16	8
WA	Columbia	Hay	2	1
WA	Franklin	Wheat	767	153
WA	Franklin	Corn	34	7
WA	Franklin	Potato	23609	11804
WA	Franklin	Dry Peas	1198	90
WA	Franklin	Green Peas	108	22
WA	Franklin	Alfalfa	639	320
WA	Franklin	Hay	4	2
WA	Franklin	Asparagus	4822	5304
WA	Franklin	Carrot	357	71
WA	Franklin	Tomato	1	1
WA	Garfield	Wheat	502	100
WA	Garfield	Barley	30	3
WA	Garfield	Alfalfa	7	4
WA	Garfield	Hay	2	1
WA	Klikitat	Wheat	283	57
WA	Klikitat	Barley	8	1
WA	Klikitat	Alfalfa	256	128
WA	Klikitat	Hay	13	5
WA	Klikitat	Tomato	3	2
WA	Walla Walla	Potato	5439	2720

WA	Walla Walla	Dry Peas	3558	1007
WA	Walla Walla	Alfalfa	106	33
WA	Walla Walla	Barley	23	2
WA	Walla Walla	Hay	13	5
WA	Walla Walla	Asparagus	791	870
WA	Pacific	Alfalfa	1	1
WA	Pacific	Hay	7	3
WA	Skamania	Alfalfa	2	1
WA	Whitman	Wheat	3347	669
WA	Whitman	Barley	160	16
WA	Whitman	Green Peas	169	34
WA	Whitman	Dry Peas	49770	14931
WA	Whitman	Alfalfa	60	30
WA	Whitman	Hay	12	4
WA	Whitman	Lentils	203	61

Focal areas of significant metribuzin use are present within the Snake River Sockeye salmon ESU (Benton, Grant Franklin, and Walla Washington counties and Umatilla and Morrow Oregon counties). These areas are, however, mainly in the migratory pathways and not the more sensitive spawning and rearing zones, Combined with the low toxicity and short duration of metribuzin in the aqueous environment, I conclude that the registered use of metribuzin will have no effect on the species of concern.

4. Summary of Risks to Endangered Salmon and Steelhead in California and the Pacific Northwest from the use of Metribuzin

Metribuzin is a product that, in it's many formulations, is used extensively for the control of noxious weeds in agriculture, residential, and recreational sites. Although it is registered for use on many large scale crops (wheat, corn, barley. alfalfa) it appears to be applied to only a small portion of the total site (0.04% of barley, 0.7% of wheat, 0.3% of corn). In addition, models and registrant studies indicate that it is only slightly or practically non-toxic to aquatic and marine/estuarine animals. As a herbicide is a potential risk to plants, however, the species of concern for this review typically exist and spawn in the open sea or in high, primarily coniferous forest environments where metribuzin would have limited impact.

With these considerations, it can be concluded that use of metribuzin under registered guidelines will not impact the salmon and steelhead populations of concern.

Table 47: Summary of Findings

Species	ESU	Finding
Steelhead	Southern California	No Effect
Steelhead	South-Central California Coast	No Effect
Steelhead	Central California Coast	No Effect
Steelhead	Central Valley California	No Effect
Steelhead	Northern California	No Effect
Steelhead	Upper Columbia River	No Effect
Steelhead	Snake River Basin	No Effect
Steelhead	Upper Willamette River	No Effect
Steelhead	Upper Willamette River	No Effect
Steelhead	Lower Columbia River	No Effect
Steelhead	Middle Columbia River	No Effect
Chinook Salmon	Sacramento River winter run	No Effect
Chinook Salmon	Snake River fall run	No Effect
Chinook Salmon	Snake River spring/summer run	No Effect
Chinook Salmon	Central Valley spring run	No Effect
Chinook Salmon	California Coastal	No Effect
Chinook Salmon	Puget Sound	No Effect
Chinook Salmon	Lower Columbia	No Effect
Chinook Salmon	Upper Willamette	No Effect
Chinook Salmon	Upper Columbia	No Effect
Coho Salmon	Central California Coast	No Effect
Coho Salmon	Southern Oregon/Northern California	No Effect
Coho Salmon	Oregon Coast	No Effect

Chum Salmon	Hood Canal summer run	No Effect
Chum Salmon	Columbia River	No Effect
Sockeye Salmon	Ozette Lake	No Effect
Sockeye Salmon	Snake River	No Effect

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Attachment 1
Reregistration Eligibility Decision for Metribuzin

Attachment 2
EPA Quantitative Use Analysis
Metribuzin

Attachment 3
Sample Labels
Metribuzin

Attachment 4
USGS Distribution of Metribuzin Use